APPENDIX A

PES SPECIAL TRUCK TRAFFIC SURVEY

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The objectives of the truck traffic survey are to estimate for non-state highway roads: (1) the percent distribution (or truck mix) of heavy-duty vehicles (HDVs) by number of axles on various functional road classifications; and (2) to estimate the daily vehicle miles traveled (DVMT) per mile contributed by HDVs. PES has calculated total road miles of each of five road types in each county throughout the state. These five road types, or functional classes (FC) of roads are: urban principal arterial; urban minor arterial; urban collector; rural major collector; and rural minor collector. These FCs are administered primarily by city and county governments and are expected to carry significant truck traffic. FCs which are not of interest include state highways (administered by CALTRANS) and local roads, which constitute the major fraction of road miles but are not expected to carry any significant amount of truck traffic.

Table A-1 presents a complete list of the Federal Highway Administration's (FHwA) functional classes, their statewide road miles, CALTRANS' estimates of AADTT (annual average daily truck traffic) and DVMT (daily vehicle miles traveled) and PES' estimates of HDV contents on each functional class. This data provides a starting point to determine which FCs should be targeted in a traffic survey. Interstates, other freeways and expressways in urban areas, and principal and minor arterials in rural areas are primarily under state jurisdiction and thus were excluded from the FCs to be used for the traffic survey. The five FCs used in the survey account for about 43,000 miles out of the state total of 170,000 miles (or 25% of total road miles) and about 12.4 million vehicle miles of the state total of 37.2 million vehicle miles (or 33% of total truck VMT).

The above estimates were a rough first approximation, based on traffic data from various CALTRANS reports. Nevertheless, these estimates indicate the magnitude of the sample universe for the traffic survey and the importance of the survey for improving estimates of statewide and county heavy-duty VMT.

A.1 DESIGN OF SURVEY PLAN

CALTRANS' AADT file for truck traffic data contains over 4,000 records for the 17,000-mile state highway system. In addition, under a FHwA funded program, CALTRANS has assembled traffic data which were originally gathered by city and county governments at 1,384 observation sites on the 86,000-mile state road system. Given the size of the existing data base and the magnitude of the sample universe, no feasible effort under this project seemed likely to substantially improve the existing traffic data. However, the existing traffic data, particularly for non-state roads, completely lacked the resolution of truck VMT by axle class or weight class. Since non-state roads are more numerous and their links are shorter than those of state highways, the 1,384 observation sites are not enough to produce an accurate estimate of all traffic VMT nor, particularly, of truck VMT.

In view of the magnitude of the sample universe and the deficiency of the existing traffic data, PES used a novel and unconventional traffic survey scheme. Ordinary traffic surveys are done by counting traffic volumes at fixed observation sites and then combining this data with link length information to yield VMT estimates. In PES' new scheme, two teams (of two persons each) drive simultaneously over a selected route in opposite directions and count numbers of trucks in the counter traffic over the entire length. Each route begins and ends at the same point. Then, the truck counts and average driving speeds of the two teams are combined to estimate truck VMT per hour over the route by the following equation:

$$VMT = (n_1 + n_2)v_1v_2/(v_1 + v_2) \qquad (A-1)$$

where VMT = vehicle miles traveled per hour

n_1, n_2 = numbers of trucks counted in counter traffic by Team 1 and Team 2

v_1, v_2 = average driving speeds of Team 1 and Team 2 over the route, as calculated from the times required for driving over the route as L/t_1 and L/t_2, respectively, where L = length of the route.

In the above equation, the speeds v_1 and v_2 are supposed to represent, respectively, the fleet average speeds in each of the two directions over the routes. This can be managed by having each driver follow the traffic in one direction. When the fleet average speeds are the same in both

directions, Equation A-1 reduces to:

$$VMT = 0.5\ (n_1 + n_2)v \qquad (A-2)$$

where v = the fleet average speed over the route.

PES selected routes which were about twenty miles long for urban streets and about 35 miles long for rural roads. Each route represented only one or two functional road classifications. Trucks in the counter traffic were counted separately for each axle class and for each functional class of roads. Such a counting scheme enabled us to later calculate the truck VMT mix for each route and for each functional class.

A.2 ROUTE SELECTION AND SURVEY EXECUTION

A.2.1 DETERMINATION OF SURVEY SAMPLE SIZE

The sample universe for the traffic survey is 40,764 miles of non-state roads: 4,374 miles of urban principal arterial; 7,469 miles of urban minor arterial; 6,765 miles of urban collector; 11,926 miles of rural major collector; and 10,230 miles of rural minor collector. (These numbers were arrived at from detailed road mile data in the HPMS file.) Although there are many miles of local roads and small fractions of non-state freeways, rural principal arterials and rural minor arterials, these functional classes were excluded from the sample universe. The reasons are that local roads were not expected to carry any significant number of HDV's, and that heavy-duty VMT on the small fractions of the latter three functional classes can be estimated rather accurately from CALTRANS traffic counts on similar roads.

Compared to the 40,764 miles of the sample universe, the sample road miles of a proposed 24 routes total about 720 miles (= 24 routes x 30 miles per route), or less than two percent of the sample universe road miles. With this low sampling rate, the selection of survey routes becomes vital for obtaining representative results for the non-state road system. For this purpose, PES compiled non-state road miles of each of the five functional classes for 58 counties in the state (see Table A-2). Furthermore, every county was categorized into one of three county groups

based on two statistics: percent of the resident population in incorporated cities in that county; and the percent of city-managed streets in the county total road miles (see Table A-3). The numerical value of the sum of these two percentages was used to group each of the 58 counties into three categories: rural (0-60); mixed (61-120); and urban (121-200).

The spatial distribution of the three county groups is depicted in Figure A-1. Urban counties are clustered around the San Francisco Bay area and the South Coast area. Mixed counties fill the middle part of the state and the areas surrounding the two urban clusters. Rural counties extend from the Owens Valley to the northern border of the state.

A summary of road miles of each functional class in each county group is shown in Table A-4. As expected from the county grouping shown in Table A-3, there exists a pattern in which urban counties have the majority of road mile in each of the three urban functional classes whereas rural and mixed counties have the majority of road miles in the two rural functional classes. However, these proportions of road miles by functional classification among the three county groups, alone, are not sufficient to determine sample allocation to each county group. Statistically sensible sample allocation requires consideration of approximate heavy-duty VMT proportions among the three county groups.

For this purpose, estimated truck daily VMT in Table A-1 is apportioned to each functional-classification/county-group combination according to its road miles. Resulting daily truck VMT estimates are presented in Table A-5. In terms of VMT, two functional classes (viz., principal and minor arterials) in the urban county group account for 51 percent of total truck VMT whereas those in the mixed county group account for 17 percent. Urban collector and rural minor collector account for only seven and five percent, respectively, and thus were excluded from the sample space. Rural major collectors account for 19 percent of total truck VMT and thus was included in the sample space. Since the great majority of truck VMT on this functional class occurs in the mixed county group, survey routes for rural major collectors were selected from roads in mixed counties.

Based on this analysis, PES selected 10 routes consisting of principal arterials alone or in combination with minor arterials from the pool of 11 urban counties. Five routes were selected from mixed counties for principal arterials and another four for major collectors. The remaining four routes were reserved for special study purposes such as preliminary pilot traffic surveys.

A.2.2 ROUTE SELECTION

A.2.2.1 Methods

The following discussion presents the methods used to select and construct individual survey routes. To construct principal and minor arterial routes in urban and mixed counties, indexed grid cell maps showing urban areas of each relevant CALTRANS District were obtained from the Cartographic Services Division of CALTRANS in Sacramento. Functional classification (FC) road maps corresponding to each selected grid cell on the District map were then obtained from CALTRANS. Urban FC maps identify which roads are interstates and freeways, principal and minor arterials, and collector streets. Circular routes of about 20 miles in length and consisting of one functional class were constructed from these maps. In some cases it was necessary to include two functional classes within one route in order to make the path circular. The selected route was then outlined on street maps available from the Auto Club of California. Distances were checked using a map mile counter to ensure the routes were around 20 miles long.

Route selection for major collectors in the rural areas of mixed counties was essentially the same as the above with one exception. Routes varying between 30 and 40 miles in length were selected directly from county-based maps provided by CALTRANS showing rural functional classifications.

All routes were screened for various conditions affecting the road accessibility including the prevalence of one-way streets, no-left-turn signs, dead ends, detours, unusual traffic control or other factors which could alter normal traffic flow. This checkout procedure was performed in one of two ways: (1) the Highway Operations Branch of each relevant

CALTRANS District office was sent copies of route maps and asked to comment on potential problems with each route and, if necessary, to suggest alternative routes; or (2) a technician would traverse the route in an automobile and report back with information on road conditions.

A.2.2.2 Results

Twenty-one traffic survey routes canvassing 13 counties in California were selected. Figure A-2 shows the locations of each selected survey route within the state. Table A-6 provides the locale, county classification (urban, mixed), functional road classification, mileage, and survey classification (pilot, full). The pilot survey included four principal arterials in Los Angeles and Orange counties. The full survey included 20 different routes located in seven urban and six mixed counties. Routes in the seven urban counties included four principal arterials, four minor arterials, and three with a combination of principal and minor arterials. Routes in the six mixed counties included five principal arterials and four major collectors. Therefore, the full survey included 12 principal arterials (7 urban and 5 mixed counties), 7 minor arterials and 4 major collectors. Detailed maps for each route are provided in Appendix B.

The lengths of the principal and minor arterial routes ranged between 20 and 24 miles and 18 and 22 miles, respectively, except for the routes which contained a mixture of both functional classes. Two minor arterial routes (Routes 5 and 12) were half the required length; each route therefore, was traversed twice in order to meet the 20-mile distance requirement. The four major collector routes ranged between 31 and 40 miles in length.

A.2.3 SURVEY EXECUTION

A.2.3.1 Pilot Survey

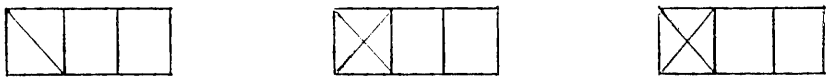
The purpose of the pilot survey was three-fold: (1) to confirm that the general method of a mobile traffic survey outlined in Section A.1 was both logistically possible and cost-effective, (2) to develop the most

efficient data recording scheme (i.e., designing useful survey forms), and (3) to determine which hours of the day the survey should cover.

To these ends, four principal arterial routes in Southern California were selected. The procedures followed during the pilot are as follows. Two survey teams, of two persons each, begin at the same predetermined point on the selected route. Ten survey trips per route per day are completed; for every trip, one team always travels clockwise around the traffic loop while the other always travels counterclockwise. The survey trips are conducted at regular intervals between the hours of six a.m. and eight p.m. Clock time and mileage are noted at the beginning and end of each trip so that average fleet speed for each team can be calculated. The duration of any emergency stop or other delays are also recorded so that calculated speeds may be adjusted. When a route contains a prespecified section over which the surveyors are not to count, the start and ending time and mileage for this section are recorded on the data form. Surveys are to take place on either Tuesdays, Wednesdays or Thursdays. These days of the week, according to CALTRANS (1967), contribute most significantly to total weekly traffic. Traffic volumes taper off considerably from Friday to Monday.

Each team counts the number of HDVs traveling in the opposite direction of traffic, noting on the survey form the number of axles and the type of the vehicle. Drivers are to obey all traffic laws and should travel at the same speed as surrounding traffic in their direction. If no vehicles are in the area, drivers are to follow the posted speed limit.

As shown in Figure A-3, Forms 1 and 2 were used for Route 1 and Routes 2 through 4, respectively. One form per trip is used. The forms separate observations first by axle class (e.g., 2-axle, 3-axle, etc.) and then by body type (e.g., 2B: 2-axle bus; 3T: 3-axle tractor without trailer; 4H: 4-axle heavy-duty vehicle). Observations were recorded in the boxes on the survey form in the following manner:



1 HDV 2 HDVs 3 HDVs

In the space provided for comments, surveyors should make note of any factors that may render the particular trip nonrepresentative in terms of normal traffic conditions.

As seen in Figure A-3, the major difference between Form 1 and Form 2 is the level of detail in recording body types for two-axle HDVs. PES quickly discovered that vehicles in the 2D category (Form 1--two-axle HDVs with double set of tires on the rear axle) encompassed a wide range of styles, sizes and weights. Many of these vehicles, it appeared, were less than 8,500 pounds in actual weight. Therefore, we needed to have clear resolution between heavy-duty vehicles (>8,500 lbs) and possible medium-duty vehicles (<8,500 lbs) so that the latter could be properly handled during subsequent analyses.

Given that mobile traffic surveys covering 24-hour periods would neither be safe nor fiscally feasible, we decided to conduct the pilot surveys over a 14-hour period starting at six a.m. under the assumption that the vast majority of daily traffic occurs between these hours. After analysis of the pilot survey data, the testing hours for the full survey were shortened to ensure that the final data set would be collected in a technically reliable and cost-efficient manner.

A.2.3.2 Full Survey

The procedures followed in the full survey are the same as the pilot survey with the following exceptions. The number of trips per route was decreased from ten to five, covering the hours between 10 a.m. and 4:30 p.m. (see Section A.3.4 -- "Determination of Sampling Schedule for Full Survey"). The survey form was also expanded to include greater specificity in recording two-axle vehicles. Figure A-4 presents the form used in the full survey. The purpose of creating more two-axle categories was to enhance the confidence in properly classifying possible medium-duty two-axle vehicles. The survey form is divided into Parts A and B so that truck counts made on one functional classification portion of a route can be separated from another. Spaces are also provided on the form to note

the time and mileage at which the functional classification of the route changes.

Truck counting precision tests were performed for two principal arterial routes in Southern California. For this test, the two teams counted trucks under the procedure described earlier. A third team would follow closely behind one of the other two teams, counting trucks in the same fashion. Ideally, the truck counts obtained from the third team should be the same as the team being followed. Upon completion of these tests, the third team had performed five precision runs on each of the two teams. Section A.4.2 presents the results of these tests.

A.3 RESULTS OF PILOT SURVEY

Pilot traffic surveys using methods described in Section A.2.3 took place between February 8, and March 1, 1984. As discussed earlier, four pilot surveys were conducted to develop the most efficient counting scheme, to acquire field experience in identifying and classifying trucks, and to obtain an indication of the diurnal truck traffic profile on surface streets. The four routes were all principal arterials located in and around Los Angeles. Traffic route specifications are given in Section A.2.2.2 and Table A-6. Route maps are shown in Appendix B.

Survey conditions during this period were fair. Weather was generally mild with no days of rain or other inclement conditions. The starting times for the ten trips was about 6:30, 8:30, 9:45, 11 a.m., 12:30, 2,3,4, 5:30; and 7:45 p.m. Each trip lasted from about 35 to 60 minutes. Because of the season and starting time, Trip No. 10 was conducted at night which hampered truck counting. During Route 2, Trip No. 8, a wrong turn was made by one of the teams, resulting in a delay of about 30 minutes; mileage off the route was estimated to be about 12 miles. During Route 3, Trip No. 9, a widespread power failure occurred in the entire Southern California region, resulting in a blackout of all street lights and signals for several minutes. Truck counting during this period was not severely affected even though traffic was heavily congested.

A.3.1 NUMBER OF HDVS BY ROUTE AND TRUCK MIX

The following section presents truck count data by number of axles and the percent distribution of truck counts by axle class, or truck mix, for all surveyed routes. Detailed, raw truck count data obtained from the surveys are presented in Appendix C, Tables C-1 through C-4.

Table A-7 presents results for the four Southern California pilot survey routes consisting of 85.7 miles of principal arterials. If the truck count grand total is divided by the corresponding mileage and the number of trips (=10), the quotient provides an indication of truck volume in terms of the number of HDVs per mile or road surveyed per trip. Average truck volume for the pilot survey routes was, therefore, 7 HDVs per mile per trip. Figure A-5 illustrates the percent contribution of each axle class to the total number of HDVs observed. Truck mix for these routes was dominated by 2-axle HDVs (59%) followed by 5+-axle HDVs (20%), 3-axle HDVs (15%), and 4-axle HDVs (5%).

A.3.2 DETERMINATION OF SAMPLING SCHEDULE FOR FULL SURVEY

During the pilot survey, fewer number of HDVs were observed at the beginning and the tail ends of the survey. This trend helped decide which survey hours would yield the most observations and most representative daily truck mix. Because of fiscal and logistical constraints, we had to limit the number of trips carried out per route for the full survey to fewer than 10.

Table A-8 presents the total number of HDVs counted by trip for each of the four routes surveyed. Figure A-6 graphically illustrates hourly variations in truck counts over all four routes. Almost three-quarters of the trucks counted were observed between Trips 3 and 8 (roughly 9:45 a.m. and 4:45 p.m.). Therefore, it was decided that the full survey should cover the period between these hours. Also, the individual trip schedule would be adjusted to accommodate five trips within the selected time period. The above criteria were developed to provide adequate coverage during the busiest truck traffic hours.

A.4 RESULTS OF FULL SURVEY

Full traffic surveys using the methods described in Section A.2.3 took place between March 22, and May 31, 1984. Urban county routes in Southern California (Routes 1X - 8) were performed between March 22 and April 19; those in the San Francisco Bay area (9 - 12) on April 25-26; in the Southern California mixed-county areas (13 - 15) during the weeks of May 3 through May 10; and in the Central Valley region (16-21) from May 16 through May 31. Traffic route specifications are given in Section A.2.2.2 and in Table A-6. Route maps are shown in Appendix B.

Survey conditions during this period were ideal. Weather for all surveys was generally fair and mild with no days of rain or other inclement conditions. Road conditions (e.g., construction, detours, obstructions or other impairments) were known in advance of the survey so that contingencies could be planned in the event of problems; no problems affecting data collection were encountered. Occasionally, wrong turns were made during individual trips, but in all cases the time and mileage accrued while off the survey route were recorded on the data sheet. The starting times for each of the five trips were about 10 a.m., 11 a.m., 1:15 p.m., 2:30 p.m., and 3:30 p.m., respectively. Each trip lasted from about 35 to 60 minutes.

A.4.1 NUMBER OF HDVS BY ROUTE AND TRUCK MIX

The following section presents truck count data by number of axles and by functional class (FC) of roads for each route surveyed. The percent distribution of truck counts by axle class, or truck mix, is given for each functional class. Detailed, raw truck count data obtained from the surveys are presented in Appendix C.

Results of the traffic surveys are summarized for each FC in Tables A-9 through A-11. Table A-9 lists the total number of HDVs counted in the seven urban- and six-mixed county routes consisting of 238.8 miles of principal arterials. Table A-10 lists same quantity, counted over the seven urban county routes consisting of 102.3 miles of minor arterials. Similarly, Table A-11 gives the total number of HDVs for the four mixed-county routes consisting of 140.6 miles of major collectors.

If the truck count grand totals for each of the three functional classes are divided by the corresponding mileage for that functional class and the number of trips (=5), the quotient provides an indication of truck volume in terms of the number HDVs per mile of road surveyed per trip. Major differences in truck traffic volume among the three FCs were evident. Truck volume for principal arterial, minor arterial, and major collector routes were 6, 3, and <1 HDVs per mile per trip, respectively. Truck volume on the four pilot survey routes (all principal arterial) average 7 HDVs per mile per trip.

Differences in truck mix, as shown on the aforementioned tables, for the three functional classes are more subtle. Figure A-7 illustrates the differences in truck mix along the three functional classifications. Two-axle HDVs represent the largest category in all three FCs -- 74% for minor arterials, 68% for principal arterials, and 52% for major collectors. The percentages of 3- and 4-axle HDVs are relatively the same among the three groups, ranging from 12 to 14% for 3-axle HDVs and 2 to 4% for 4-axle HDVs. The major differences occur in the 5+axle category: 32% of the HDVs on major collectors are 5+axle, 15% on principal arterials, and 9% on minor arterials. These results appear reasonable if one realizes that minor arterials, like local streets for example, are used for short-distance deliveries utilizing a greater number of lighter 2-axle HDVs, while on larger urban principal arterials and rural major collectors traffic may include more long-haul, heavier HDVs.

A.4.2 TRUCK COUNTING PRECISION TESTS

During the surveys conducted on Routes 1X (Carson, principal arterial) and 2X (Garden Grove, principal arterial), duplicate truck counts were performed using the method described in Section A.2.3.2. The purpose of these duplicate runs was to assess the precision of our truck counting scheme. Tables A-12 and A-13 present data for duplicate test runs on Routes 1X and 2X, respectively. Analyses down to the sub-axle category (e.g., 2H, 2V, etc.) was necessary to determine the source of counting variations.

As used in the aforementioned tables, absolute difference (AD) is defined as $|N_{a,i,j}-N_{b,i,j}|$, where $N_{a,i,j}$ and $N_{b,i,j}$ are the truck counts for Team A and Team B, respectively, for trip i and axle class j. The mean absolute difference ($\bar{X}_{jd}$) is defined as the sum of the absolute differences for an axle class j over the five trips, or:

$$\bar{X}_{jd} = \sum_{i} \left(|N_{a,i,j} - N_{b,i,j}| \right) / n \qquad \text{(A-3)}$$

where n = the number of trips (5). The average of HDVs counted per trip was determined from $(N_{a,i,j} + N_{b,i,j})/2$. The average number of HDVs counted over all trips ($\bar{X}_{jn}$) was calculated using the following formula:

$$\bar{X}_{jn} = \sum_{i} \left(N_{a,i,j} + N_{b,i,j} \right) / 2 \; n \qquad \text{(A-4)}$$

where n = the number of trips. Subtotals for AD and $\bar{X}_{jd}$ in Tables A-12 and A-13 are calculated directly from the corresponding truck count subtotal, not from the sum of the calculated AD and $\bar{X}_{jd}$ over each axle class. For example, for trip 5 in Table A-12, the two teams counted a total 9 and 10 trucks, respectively, for the aggregate category, 2V through 2CV; the absolute difference is, therefore, 1.

In Route 1X, the absolute differences in dual counts ranged from 0 to 5 among the axle classes and the five trips. The largest difference occurred during the third trip in the 2PF category and in the subtotal of the 2V through 2CV categories. This seems quite reasonable because HDVs in the 2PF category are rather abundant and could be misjudged as being a genuine heavy-duty vehicle (therefore classified as a 2H) or a medium-duty vehicle, in which case it would be left out of the survey. The absolute differences in the heavier classes (i.e., 2H, 2B, 2T, 3H, 3B, 3T, 4H, 5H and 6,7,8) are generally smaller than those in 2PF and the aggregated class of 2V through 2CV.

Table A-14 gives the percent deviation between simultaneous truck counts for Route 1X. When averaged over five trips, the percent deviation (or precision) in truck counting for each of the four aggregated classes varies from 2.0% in the survey total-based category to 12.8% in the

lightest category, 2L, (i.e., 2V through 2CV). Survey total-based estimates rely on total truck count sums over all axle classes. Mean percent deviation (MD) is defined as $(\bar{X}_{jd}/\bar{X}_{jn})(100)$ where $\bar{X}_{jd}$ and $\bar{X}_{jn}$ are the mean absolute difference and average number of HDVs counted over all trips as defined in Equations A-3 and A-4, respectively. For example, the MD for the 3-axle category in Table A-14 equals (0.6/20.3)(100), or 3.0.

Results of the simultaneous surveys on Route 2X are more or less similar to those on Route 1X. However, both the mean absolute differences and mean percent deviations (see Table A-15) are somewhat higher. These observations are generally due to the fewer number of counts in the 3- and 4+axle categories in Route 2X. Survey total-based MDs for Routes 1X and 2X were 2.0 and 2.7%, respectively.

Since the irreducible distance between the simultaneous survey teams itself causes some differences in HDV countings, actual deviation among different survey teams are probably somewhat smaller than the results that the simultaneous surveys would indicate. Therefore, we conclude that on a total survey basis, the actual recording of the truck counts does not create an important source of uncertainty.

A.5 ESTIMATION OF DAILY VEHICLE MILES TRAVELED

All traffic surveys were conducted over discrete intervals during the peak hours of traffic. Since the traffic survey trips were not conducted on a continuous basis during the survey hours (i.e., 10 a.m. to 4:30 p.m.), PES developed a method of estimating the number of HDVs expected during the times, between survey trips, when traffic was not being counted; this period hereinafter will be known as the survey gap. PES also devised a method for extrapolating traffic count data gathered during the approximately 6.5-hour surveys to estimated 24-hour daily totals. The methods discussed in the following section provide the basis for estimating daily vehicle miles traveled (DVMT). Figure A-8 outlines how DVMT was calculated. Table and equation numbers cited in the figure shows where relevant data sets and formulas may be found in the report.

To determine DVMT for HDVs, we must first estimate VMT observed during

the survey trips and VMT expected during the survey gaps. VMT for the survey trips and for the survey gaps were then summed to give a total VMT for the survey route. Survey VMT was then extrapolated to a 24-hour period using methods described later.

A.5.1 VMT ESTIMATION

The first step in estimating DVMT was to calculate VMT/hour for each route by trip. Equation A-1 was used to estimate VMT/hour and can be restated as follows:

$$VMTH_{i,j} = \frac{(n_{i,a,j} + n_{i,b,j})(v_{i,a,j})(v_{i,b,j})}{(v_{i,a,j} + v_{i,b,j})} \qquad (A-5)$$

where $VMTH_{i,j}$ = vehicles miles traveled per hour for Route i, Trip j,

$n_{i,a,j}$ = the number of HDVs counted by Team A for Route i, Trip j,

$n_{i,b,j}$ = the number of HDVs counted by Team B for Route i, Trip j,

$v_{i,a,j}$ = the average driving speed of Team A over Route i, Trip j in miles per hour, and

$v_{i,b,j}$ = the average driving speed of Team B over Route i, Trip j in miles per hour.

The total number of vehicles counted by Team A and Team B for each route by trip is given in Table A-16; average driving speeds for both teams are given in Table A-17. Table A-18 shows VMT/hour for each route by trip using Equation A-5.

VMT/hr by trip was then converted to VMT by multiplying by the trip duration using the following formula:

$$VMT_{i,j} = VMTH_{i,j}(t_{i,j})/60 \qquad (A-6)$$

where $VMT_{i,j}$ = vehicle miles traveled for Route i, Trip j, and

$t_{i,j}$ = the duration of trip j, in minutes.

The duration of each survey trip and the estimated VMT by trip for each route are given in Tables A-19 and A-20, respectively.

The next step was to estimate VMT during the survey gaps. Rates of VMT accumulation were estimated for each gap period using the following formula:

$$R_{i,k} = (VMTH_{i,j} + VMTH_{i,j+1})/2 \qquad (A-7)$$

where $R_{i,k}$ = the average VMT per hour for Route i, Gap k; and

$VMTH_{i,j}$, $VMTH_{i,j+1}$ = vehicle miles traveled per hour calculated for Route i, Trips j and j+1, respectively, from Eq. (A-5).

VMT for the survey gaps was then estimated by multiplying the average VMT per hour during the gaps by the gap duration using the following formula:

$$VMT_{i,k} = R_{i,k}(t_{i,k})/60 \qquad (A-8)$$

where $VMT_{i,k}$ = vehicle miles traveled for Route i, Gap k, and
$t_{i,k}$ = duration of Route i, Gap k, in minutes.

The duration of each survey gap and its associated VMT for each route are shown in Tables A-21 and A-22.

VMT for the survey trips and the associated gaps where then summed to provide a total for the survey period using the following equation:

$$VMT_i = \sum_k VMT_{i,k} + \sum_j VMT_{i,j} \qquad (A-9)$$

where VMT_i = total vehicle miles traveled for Route i during the survey,

$VMT_{i,j}$, $VMT_{i,k}$ = vehicle miles traveled on Route i during Trip j and Gap k, respectively.

A.5.2 DVMT ESTIMATION

To extrapolate the total VMT estimated for the survey period (VMT_i) to 24-hour DVMT, PES used a diurnal truck traffic profile for state freeways and highways developed by CALTRANS (1967). Table A-23 shows the percent distribution of 2-, 3-, 4- and 5+axle HDVs by hour of the day. From the diurnal data the percent of total daily traffic covered by each survey was estimated based on the starting time of the first trip and the ending time of the final trip. Total VMT for each route was divided by this percentage to obtain an estimate of 24-hour DVMT.

The CALTRANS data typifies HDV traffic on freeways and highways, and, therefore, an assumption was made that the 2-axle category would be a good surrogate for the distribution of HDVs on non-state roads within the functional classifications of interest. To assess the reliability of this assumption, data from the pilot survey consisting of four principal arterial routes was further analyzed. This data was deemed appropriate since the survey hours encompassed an approximately 14-hour period as opposed to the 6-hour period for the full survey.

The number of HDVs during the survey gaps and during the survey trips for each route were apportioned into discrete hourly intervals and then summed over the four routes. Tables A-8 and A-24 present the number of HDVs counted by trip, the starting and ending times and trip durations for the pilot survey routes. The number of HDVs in each hourly interval was estimated by calculating the number of HDVs counted per minute during the survey trips which fall into the interval. If there was a gap in counting during a particular hourly interval, the number of HDVs during this gap was estimated by averaging the counts per minute for the survey trips occurring immediately before and after the gap and then multiplying by the remaining minutes in the interval corresponding to the gap period. The following calculation gives an example as to how the number of trucks for a discrete hourly interval was estimated.

Given:

Route 1, Trip 1:	time = 0630 - 0726 duration = 56 min. no. of HDVs = 121	Route 1, Trip 2: time = 0848 - 0932 duration = 44 min. no. of HDVs = 202

No. of HDVs in interval 0700-0800 = (121/45)(26min) + (121/56 + 202/44)(34 min)/2 = 171

Note that each rate (count/minute) are multiplied by durations which sum to 60 minutes (26 + 34).

Figure A-9 shows the results of these calculations summed over all four routes. Figure A-10 presents graphs of CALTRANS diurnal data and the pilot survey data apportioned into hourly intervals in terms of percent of total counts. The two data sets do seem to have peaks and valleys at around the same hours of the day. However, the CALTRANS data represents a 24-hour period while the pilot survey data represents an 11-hour period. The third graph in the figure (hexagonal data point symbols) shows the pilot survey data after an adjustment was made to predict what the data would look like over a 24-hour period. This analysis appears to show qualitatively that the CALTRANS diurnal profile data for 2-axle HDVs is similar to the overall hourly truck traffic pattern observed during the surveys.

To calculate the fraction of daily coverage of each survey, the starting and ending times of each survey route (see Table A-19) was superimposed onto a graph of the CALTRANS data shown in Figure A-11. The area within those two endpoints on the graph was determined; this result represents the fraction of daily traffic counted during the survey route. Table A-24 presents a summary by route of the VMT estimated during the survey trips and associated gaps, the fraction of daily traffic observed during the survey period, and DVMT for each route. DVMT was estimated using the following formula: $VMT_{T,i} = VMT_i/f_i$, where $VMT_{T,i}$ is the total DVMT for Route i, and f_i, the fraction of total daily traffic observed for Route i.

A.6 ESTIMATION OF DVMT PER MILE BY FUNCTIONAL CLASS AND BY AXLE CLASS

One of the objectives of the traffic surveys is to provide a basis for estimating HDVMT on non-state roads by functional classification in California in order that a comparison to the CALTRANS AADTT data can be

made. The following section presents DVMT survey results in terms of miles of road surveyed and functional classification.

Table A-25 presents the results of dividing the estimated DVMT for each route by the route length. DVMT per mile by functional classification was estimated by calculating the mean values for the principal and minor arterial routes (PAs and MAs), and major collector (MJC) routes. Mean DVMT per mile and the standard deviation were estimated to be 1,126 ± 444 for PAs; 598 ± 223 for MAs; and 237 ± 67 for MJCs. The PA:MA:MJC DVMT per mile ratio is about 5:3:1. Figure A-12 graphically illustrates the relationship among the functional classes in terms of DVMT per mile.

Table A-26 presents DVMT per mile by axle class and functional class. These results were estimated by multiplying DVMT per mile totals by the functional class-specific truck mix information provided in Tables A-9 through A-11.

Table A-1. CHARACTERISTICS OF EACH FUNCTIONAL ROAD TYPES IN 1982

Road Type	Road Miles	% State Jurisdiction	AADT (10^3 Vehs)	DVMT (10^6 vhe-mi)	Estimated HDV Content	Truck DVMT (10^6 veh.mi)
URBAN						
Interstate†	803	100%	97.3	78.1	8%	6.2
Other Fwy & Expwy†	1,199	94%	64.3	77.1	9%	6.9
Principal Arterial	5,404	18%	18.4	99.3	5%	5.0
Minor Arterial	7,482	2%	8.3	62.3	6%	3.7
Collector	6,769	1%	3.3	22.3	4%	0.9
Local	40,858	0%*	0.3	12.2	0%*	0%*
Urban Total	62,514		5.6	351.3		22.7
RURAL						
Interstate†	1,459	100%	17.0	24.8	22%	5.5
Principal Arterial†	3,098	97%	9.3	28.8	24%	4.0
Minor Arterial†	6,752	98%	2.9	19.8	11%	2.2
Major Collector	12,975	8%	1.7	22.7	10%	2.3
Minor Collector	10,240	2%	0.7	6.8	8%	0.5
Local	76,850	0%*	0.2%	11.6	0%*	0*
Rural Total	111,374		1.0	114.5		14.5
Grand Total	173,888		2.7	465.8		37.2

†These road types are predominantly managed by CALTRANS.
*An exact estimate is not available, but is expected to be negligibly small.

Table A-2. ESTIMATED MILES OF EACH OF FIVE NON-STATE ROAD TYPES IN EACH COUNTY

County	Urban Principal Arterial	Urban Minor Arterial	Urban Collector	Rural Major Collector	Rural Minor Collector
Alameda	125	358	314	65	12
Alpine	0	0	0	35	10
Amador	0	0	0	55	60
Butte	21	61	58	227	139
Calaveras	0	0	0	133	52
Colusa	0	0	0	39	143
Contra Costa	112	213	173	134	67
Del Norte	0	0	0	43	29
El Dorado	0	29	35	137	196
Fresno	105	189	150	652	721
Glenn	0	0	0	161	133
Humboldt	11	24	21	324	213
Imperial	4	36	54	407	588
Inyo	0	0	0	430	98
Kern	79	157	104	486	499
Kings	0	27	26	205	129
Lake	0	0	0	94	38
Lassen	0	0	11	188	116
Los Angeles	2,003	1,929	2,015	539	841
Madera	0	10	13	164	216
Marin	25	75	137	59	0
Mariposa	0	0	0	116	121
Mendocino	0	9	13	124	202
Merced	11	28	40	229	295
Modoc	0	0	0	177	166
Mono	0	0	0	96	77
Monterey	23	49	83	201	185
Napa	0	28	13	79	63
Nevada	0	12	4	90	152
Orange	500	606	347	68	2
Placer	17	32	23	129	176
Plumas	0	0	0	111	144
Riverside	94	297	309	653	606
Sacramento	190	210	252	140	149
San Benito	0	0	7	83	37
San Bernardino	187	563	455	1,131	368

Table A-2. ESTIMATED MILES OF EACH OF FIVE NON-STATE ROAD TYPES IN EACH COUNTY (CONTINUED)

County	Urban Principal Arterial	Urban Minor Arterial	Urban Collector	Rural Major Collector	Rural Minor Collector
San Diego	191	748	558	351	219
San Franciso	96	113	95	0	0
San Joaquin	57	71	123	318	282
San Luis Obispo	0	50	68	306	157
San Mateo	6	304	189	0	25
Santa Barbara	18	113	110	223	68
Santa Clara	207	429	289	43	131
Santa Cruz	15	60	54	42	15
Shasta	3	40	50	270	174
Sierra	0	0	0	62	86
Siskiyou	0	0	9	280	333
Solano	27	93	72	104	42
Sonoma	19	89	83	207	140
Stanislaus	37	47	83	264	270
Sutter	2	22	16	92	110
Tehama	0	11	11	160	142
Trinity	0	0	0	142	142
Tulare	19	105	53	577	492
Tuolumne	0	0	0	81	143
Ventura	160	170	164	148	51
Yolo	8	33	59	113	119
Yuba	1	29	22	139	46

Table A-3. COUNTY GROUPING BASED ON PERCENT OF POPULATION IN INCORPORATED CITIES AND PERCENT OF ROAD MILES UNDER CITY JURISDICTION

County	% Popl. In Cities[a] (A)	% Roads In Cities[b] (B)	A+B	County Category[c]
Alameda	89	78	167	U
Alpine	0	0	0	R
Amador	36	8	44	R
Butte	44	16	60	R
Calaveras	10	2	12	R
Colusa	43	4	47	R
Contra Costa	71	58	129	U
Del Norte	17	4	21	R
El Dorado	30	12	42	R
Fresno	67	27	94	M
Glenn	42	4	46	R
Humboldt	48	14	62	M
Imperial	71	7	78	M
Inyo	19	1	20	R
Kern	46	25	71	M
Kings	56	15	71	M
Lake	33	10	43	R
Lassen	29	2	31	R
Los Angeles	87	77	164	U
Madera	42	8	50	R
Marin	72	52	124	U
Mariposa	0	0	0	R
Mendocino	32	6	38	R
Merced	58	13	71	M
Modoc	35	3	38	R
Mono	0	0	0	R
Monterey	71	26	97	M
Napa	64	28	92	M
Nevada	17	5	22	R
Orange	86	81	167	U
Placer	38	18	56	R
Plumas	11	2	13	R
Riverside	58	36	94	M
Sacramento	38	31	69	M
San Benito	52	9	61	M

Table A-3. COUNTY GROUPING BASED ON PERCENT OF POPULATION IN INCORPORATED CITIES AND PERCENT OF ROAD MILES UNDER CITY JURISDICTION (CONTINUED)

County	% Popl. In Cities[a] (A)	% Roads In Cities[b] (B)	A+B	County Category[c]
San Bernardino	65	32	97	M
San Diego	80	61	141	U
San Francisco	100	96	196	U
San Joaquin	69	32	101	M
San Luis Obispo	60	21	81	M
San Mateo	88	71	159	U
Santa Barbara	52	30	82	M
Santa Clara	92	76	168	U
Santa Cruz	43	27	70	M
Shasta	42	15	57	R
Sierra	35	1	36	R
Siskiyou	45	7	52	R
Solano	93	47	140	U
Sonoma	56	25	81	M
Stanislaus	67	28	95	M
Sutter	43	8	51	R
Tehama	38	6	44	R
Trinity	0	0	0	R
Tulare	52	14	66	M
Tuolumne	10	3	13	R
Ventura	83	62	145	U
Yolo	61	16	77	M
Yuba	23	9	32	R

[a]Source: Developed from data found in "California County Fact Book 1983", County Supervisors Association of California, Sacramento, CA

[b]Source: Developed from data provided by Jerry Delavan, Division of Highways and Programming, CALTRANS, 8/18/83

[c]R = Mostly rural = $0 \leq (A+B) \leq 60$
M = Partly rural and partly urban (mixed) = $61 \leq (A+B) \leq 120$
U = Mostly urban = $121 \leq (A+B) \leq 200$

Table A-4. ESTIMATED STATEWIDE ROAD MILES OF FIVE NON-STATE ROAD TYPES

	FUNCTIONAL ROAD CLASS				
	URBAN			RURAL	
County Group	Principal Arterial	Minor Arterial	Collector	Major Collector	Minor Collector
Urban	3,543	5,038	4,353	1,511	1,390
Mixed	877	2,176	2,147	6,640	5,396
Rural	44	255	265	3,775	3,444
TOTAL	4,374	7,469	6,765	11,926	10,230

Table A-5. ESTIMATED DAILY TRUCK VMT ON NON-STATE ROADS
(million vehicle miles)

County Group	Principal Arterial	Minor Arterial	Collector	Major Collector	Minor Collector	State Total
Urban	3.2 (29%)	2.5 (22%)	0.6 (5%)	0.3 (2%)	0.1 (1%)	6.6 (59%)
Mixed	0.8 (7%)	1.1 (10%)	0.3 (2%)	1.2 (11%)	0.3 (2%)	3.7 (32%)
Rural	0.0 (0%)	0.1 (1%)	0.0 (0%)	0.7 (6%)	0.2 (2%)	1.1 (9%)
Sub-Total	4.0 (36%)	3.7 (33%)	0.9 (7%)	2.1 (19%)	0.5 (5%)	11.3 (100%)

Note: Due to round-off, some of the column and row totals do not match the sums of the elements.

Table A-6. SPECIFICATIONS OF ROUTES USED IN THE PILOT AND FULL TRAFFIC SURVEYS

Route Code	Location	County Type[a]	Functional Classification[b]	Mileage	Survey Type P=Pilot, F=Full
1	Carson	LA/U	PA	20.9	P
1X	Carson	LA/U	PA	20.5	F
2	Garden Grove	OR/U	PA	22.0	P
2X	Garden Grove	OR/U	PA	22.0	F
3	San Fernando Valley	LA/U	PA	20.6	P
3X	San Fernando Valley	LA/U	PA	20.6	F
4	Pico Rivera	LA/U	PA	22.2	P
5	Northridge	LA/U	MA	17.8	F
6	Garden Grove	OR/U	MA	21.0	F
7A	San Diego/Miramar	SD/U	PA	13.0	F
7B	San Diego/Miramar	SD/U	MA	7.8	F
8A	San Diego/Downtown	SD/U	PA	11.7	F
8B	San Diego/Downtwon	SD/U	MA	8.0	F
9	Redwood City	SM/U	MA	21.9	F
10	Sunnyvale	SCL/U	PA	21.9	F
11A	San Francisco	SF/U	PA	17.1	F
11B	San Francisco	SF/U	MA	3.8	F
12	Oakland	AL/U	MA	22.0	F
13	San Bernardino	SBDO/M	PA	24.3	F
14	Riverside	RIV/M	PA	22.2	F
15	Riverside County	RIV/M	MJC	30.6	F
16	Kern County	K/M	MJC	34.2	F
17	Bakersfield	K/M	PA	22.3	F
18	Stockton	SJ/M	MJC	35.5	F
19	Sacramento	SAC/M	PA	22.0	F
20	Fresno County	F/M	MJC	40.3	F
21	Fresno	F/M	PA	21.2	F

[a] U = urban county, M = mixed county as defined by Table A-3

[b] PA = principal arterial, MA = minor arterial, MJC = major collector

Table A-7. TOTAL NUMBER OF HDVS COUNTED BY ROUTE AND TRUCK MIX BY AXLE CLASS FOR PILOT SURVEY ROUTES

No. of Axles	Route Code[a]				Totals by Axles	Truck Mix (%)
	1	2	3	4		
2	711	877	1,047	1,008	3,643	59.3
3	302	132	214	295	943	15.3
4	114	32	59	119	324	5.3
5+	639	85	99	409	1,232	20.1
TOTALS	1,766	1,126	1,419	1,831	6,142	100.0

[a]Refer to Table A-6 for route specifications

Table A-8. TOTAL NUMBER OF HDVS COUNTED BY ROUTE BY TRIP FOR PILOT STUDY

Route	Trip Number										Totals by Route
	1	2	3	4	5	6	7	8	9	10	
1	121	202	208	246	216	284	221	168	79	21	1,766
2	76	135	145	147	141	132	137	116	79	18	1,126
3	93	210	184	179	143	172	144	136	90	68	1,419
4	127	229	237	282	210	269	270	147	42	18	1,831

Table A-9. TOTAL NUMBER OF HDVS COUNTED BY ROUTE AND TRUCK MIX BY AXLE CLASS FOR PRINCIPAL ARTERIAL ROUTES

No. of Axles	Route Code[a]												Totals by Axle	Truck Mix (%)
	1X	2X	3X	7A	8A	10	11A	13	14	17	19	21		
2	449	509	656	353	149	357	507	273	255	357	418	322	4,605	68.4
3	187	65	98	127	34	61	68	40	35	52	117	71	955	14.2
4	53	17	24	21	1	12	13	13	12	4	19	9	198	2.9
5+	330	60	74	101	18	53	60	40	41	18	79	102	976	14.5
TOTAL	1,019	651	852	602	202	483	648	366	343	431	633	504	6,734	100.0

[a]Refer to Table A-6 for route specifications. Total surveyed mileage for this functional class = 238.8.

Table A-10. TOTAL NUMBER OF HDVS COUNTED BY ROUTE AND TRUCK MIX BY AXLE CLASS FOR MINOR ARTERIAL ROUTES

No. of Axles	Route Code[a]							Totals by Axle	Truck Mix (%)
	5	6	7B	8B	9	11B	12		
2	207	182	113	157	189	43	380	1,271	74.4
3	45	24	42	37	38	2	59	247	14.4
4	8	7	3	2	5	0	12	37	2.2
5+	9	13	20	2	25	0	85	254	9.0
TOTAL	269	226	178	198	257	45	536	1,709	100.0

[a]Refer to Table A-6 for route specifications. Total surveyed mileage for this functional class = 102.3.

Table A-11. TOTAL NUMBER OF HDVS COUNTED BY ROUTE AND TRUCK MIX BY AXLE CLASS FOR MAJOR COLLECTOR ROUTES

No. of Axles	Route Code [a]				Totals by Axle	Truck Mix (%)
	15	16	18	20		
2	72	64	51	51	238	52.0
3	8	25	9	13	55	12.0
4	7	4	5	2	18	3.9
5+	22	53	36	36	147	32.1
TOTAL	109	146	101	102	458	100.0

[a]Refer to Table A-6 for route specifications. Total surveyed mileage for this functional class = 140.6.

Table A-12. ROUTE 1X TRAFFIC SURVEY -- RESULTS OF SIMULTANEOUS OBSERVATION TEST RUNS

Axle Class	Trip Number										Absolute Difference					Mean Over All Trips	Average Number of HDVs Counted by Trip					Mean Over All Trips
	1		2		3		4		5		1	2	3	4	5		1	2	3	4	5	
2H	22	22	29	27	24	25	29	28	15	14	0	2	1	1	1	1.0	22.0	28.0	24.5	28.5	14.5	23.5
2B	1	1	2	2	2	2	5	6	4	4	0	0	0	1	0	0.2	1.0	2.0	2.0	5.5	4.0	2.9
2T	3	4	5	5	0	0	0	0	2	2	1	0	0	0	0	0.2	3.5	5.0	0.0	0.0	2.0	2.1
Subtotal	26	27	36	34	26	27	34	34	21	20	1	2	1	0	1	1.0	26.5	35.0	26.5	34.0	20.5	28.5
2V	8	7	3	3	0	0	4	4	0	0	1	0	0	0	0	0.2	7.5	3.0	0.0	4.0	0.0	2.9
2PF	4	3	9	9	11	6	8	9	6	7	1	0	5	1	1	1.6	3.5	9.0	8.5	8.5	6.5	7.2
2PC	0	0	0	0	0	0	2	1	0	0	0	0	0	1	0	0.2	0.0	0.0	0.0	1.5	0.0	0.3
2PB	1	0	0	0	0	0	1	1	0	2	1	0	0	0	2	0.6	0.5	0.0	0.0	1.0	1.0	0.5
2W	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	3.0	0.0	0.0	0.6
2MH	0	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0.2	0.0	0.0	0.5	1.0	0.0	0.3
2MB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2CV	2	2	2	2	1	2	4	4	3	1	0	0	1	0	2	0.6	2.0	2.0	1.5	4.0	2.0	2.3
Subtotal	15	12	14	14	16	11	20	20	9	10	3	0	5	0	1	1.8	13.5	14.0	13.5	20.0	9.5	14.1
3H	15	14	15	16	17	18	17	16	8	8	1	1	1	1	0	0.8	14.5	15.5	17.5	16.5	8.0	14.4
3B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3T	6	6	4	3	7	6	9	8	5	5	0	1	1	1	0	0.6	3.5	6.5	8.5	6.5	5.0	5.9
Subtotal	21	20	19	19	24	24	26	24	13	13	1	0	0	2	0	0.6	20.5	19.0	24.0	25.0	13.0	20.3
4H	4	5	6	6	6	6	4	6	4	4	1	0	0	2	0	0.6	4.5	6.0	6.0	5.0	4.0	5.1
5H	28	27	34	36	35	34	40	41	23	23	1	2	1	1	0	1.0	27.5	35.0	34.5	40.5	23.0	32.1
6,7,8	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0.2	1.0	0.5	0.0	0.0	0.0	0.3
Subtotal	33	33	41	42	41	40	44	47	27	27	0	1	1	3	0	1.0	33.0	41.5	40.5	45.5	27.0	37.5
TOTAL	95	92	110	109	107	102	124	125	70	70	3	1	5	1	0	2.0	93.5	109.5	104.5	124.5	20.0	100.4

Table A-13. ROUTE 2X TRAFFIC SURVEY -- RESULTS OF SIMULTANEOUS OBSERVATION TEST RUNS

Axle Class	Trip Number										Absolute Difference					Mean Over All Trips	Average Number of HDVs Counted by Trip					Mean Over All Trips
	1		2		3		4		5		1	2	3	4	5		1	2	3	4	5	
2H	19	17	23	22	20	18	29	28	15	13	2	1	2	1	2	1.6	18.0	22.5	19.0	28.5	14.0	20.4
2B	7	7	8	8	8	8	9	10	12	12	0	0	0	1	0	0.2	7.0	8.0	8.0	9.5	12.0	8.9
2T	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	2.0	0.0	0.0	0.0	0.4
Subtotal	26	24	33	32	28	26	38	38	27	25	2	1	2	0	2	1.4	25.0	32.5	27.0	38.0	26.0	29.7
2V	4	4	3	3	2	2	3	1	3	5	0	0	0	2	2	0.8	4.0	3.0	2.0	2.0	4.0	3.0
2PF	7	8	6	8	11	11	12	10	10	10	1	2	0	2	0	1.0	7.5	7.0	11.0	11.0	10.0	9.3
2PC	0	0	0	1	0	0	0	1	0	1	0	1	0	1	1	0.6	0.0	0.5	0.0	0.5	0.5	0.3
2PB	0	1	0	1	2	3	2	3	0	1	1	1	1	1	1	1.0	0.5	0.5	2.5	2.5	0.5	1.3
2W	1	1	1	1	3	3	0	0	0	0	0	0	0	0	0	0.0	1.0	1.0	3.0	0.0	0.0	1.0
2MH	0	0	1	1	2	2	3	3	1	1	0	0	0	0	0	0.0	0.0	1.0	2.0	3.0	1.0	1.4
2MB	2	2	0	0	1	1	3	3	0	0	0	0	0	0	0	0.0	2.0	0.0	1.0	3.0	0.0	1.2
2CV	5	5	5	5	3	3	6	8	7	6	0	0	0	2	1	0.6	5.0	5.0	3.0	7.0	6.5	5.3
Subtotal	19	21	16	20	24	25	29	29	21	24	2	4	1	0	3	2.0	20.0	18.0	24.5	29.0	22.5	22.8
3H	1	1	8	8	4	3	4	4	4	3	0	0	1	0	1	0.4	1.0	8.0	3.5	4.0	3.5	4.0
3B	0	0	0	0	2	2	2	1	1	1	0	0	0	1	0	0.2	0.0	0.0	2.0	1.5	1.0	0.9
3T	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0.0	0.0	0.0	1.0	1.0	1.0	0.6
Subtotal	1	1	8	8	7	6	7	6	6	5	0	0	1	1	1	0.6	1.0	8.0	6.5	6.5	5.5	5.5
4H	3	3	1	1	2	2	1	1	1	1	0	0	0	0	0	0.0	3.0	1.0	2.0	1.0	1.0	1.6
5H	7	5	7	7	4	4	8	8	4	5	2	0	0	0	1	0.6	6.0	7.0	4.0	8.0	4.5	5.9
6,7,8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	10	8	8	8	6	6	9	9	5	6	2	0	0	0	1	0.6	9.0	8.0	6.0	9.0	5.5	7.5
TOTAL	56	54	65	68	65	63	83	82	59	60	2	3	2	1	1	1.8	55.0	66.5	64.0	82.5	59.5	65.5

Table A-14. ROUTE 1X TRAFFIC SURVEY -- PERCENT DEVIATION BETWEEN SIMULTANEOUS TRAFFIC COUNTS

Category[a]	Percent Deviation by Trip					Mean Deviation
	1	2	3	4	5	
Axle Class-Based:						
2-heavy	3.8	5.7	3.8	0.0	4.9	3.5
2-light	22.2	0.0	37.0	0.0	10.5	12.8
3	4.9	0.0	0.0	8.0	0.0	3.0
4+	0.0	2.4	2.5	6.6	0.0	2.7
Survey Total-Based:	3.2	0.9	4.8	0.8	0.0	2.0

[a]2-heavy based on sum of truck counts for axle classes 2H, 2B, 2T. 2-light based on sum of truck counts for axle classes 2V, 2PF, 2PC, 2PB, 2W, 2MH, 2MB, 2CV, respectively. 3 and 4+ based on similar sums for 3H, 3B, 3T and 4H, 5H, 6,7,8, respectively. Survey total-based relies on truck count sums over all axle classes.

Table A-15. ROUTE 2X TRAFFIC SURVEY -- PERCENT DEVIATION BETWEEN SIMULTANEOUS TRAFFIC COUNTS

Category [a]	Percent Deviation by Trip					Mean Deviation
	1	2	3	4	5	
Axle Class-Based:						
2-heavy	8.0	3.1	7.4	0.0	7.7	4.7
2-light	10.0	22.2	4.1	0.0	13.3	8.8
3	0.0	0.0	15.4	15.4	18.2	10.9
4+	22.2	0.0	0.0	0.0	18.2	8.0
Survey Total-Based:	3.6	4.5	3.1	1.2	1.7	2.7

[a] 2-heavy based on sum of truck counts for axle classes 2H, 2B, 2T. 2-light based on sum of truck counts for axle classes 2V, 2PF, 2PC, 2PB, 2W, 2MH, 2MB, 2CV, respectively. 3 and 4+ based on similar sums for 3H, 3B, 3T and 4H, 5H, 6,7,8, respectively. Survey total-based relies on truck count sums over all axle classes.

Table A-16. NUMBER OF HDVS COUNTED BY ROUTE BY TRIP FOR THE FULL SURVEY

Route	Trip Number					Totals by Route
	1	2	3	4	5	
1X	209	208	215	248	139	1,019
2X	120	122	127	161	121	651
3X	145	200	162	196	149	852
5	43	47	51	68	60	269
6	41	42	41	70	32	226
7A	116	127	147	115	97	602
7B	41	41	32	29	35	178
8A	37	48	39	40	38	202
8B	38	42	36	26	56	198
9	47	48	51	66	45	257
10	84	98	95	112	94	483
11A	132	135	112	147	122	648
11B	12	9	13	8	3	45
12	89	114	105	128	100	536
13	78	57	90	86	55	366
14	62	66	87	77	51	343
15	29	11	19	28	22	109
16	29	19	23	34	41	146
17	66	88	103	105	69	431
18	22	15	21	30	13	101
19	125	145	138	135	90	633
20	26	20	18	15	23	102
21	90	104	110	99	101	504
TOTAL						8,901

Table A-17. AVERAGE TRIP VELOCITIES OF SURVEY TEAMS OVER EACH ROUTE (In Miles Per Hour)

Route	Trip Number[a]									
	1		2		3		4		5	
	Va	Vb	Va	Vb	Va	Vb	Va	Vb	Va	Vb
1X	23.4	27.8	28.0	26.0	30.0	25.0	26.2	25.1	26.9	23.4
2X	26.9	25.8	24.0	24.5	25.9	26.0	22.8	25.9	22.4	22.7
3X	30.5	28.4	29.7	27.1	28.3	25.0	26.9	26.0	27.7	23.5
5	27.8	27.0	27.1	27.0	28.5	28.4	28.5	27.0	27.1	27.7
6	30.1	28.4	28.5	28.4	28.2	27.2	26.2	26.1	26.9	25.6
7A	35.0	30.5	30.5	27.9	29.1	28.7	28.1	29.1	29.1	25.2
7B	33.9	38.5	31.2	30.0	36.5	30.8	26.3	24.0	33.9	30.4
8A	33.7	35.1	30.8	38.7	30.8	34.8	30.8	38.7	29.5	36.8
8B	19.3	19.3	16.5	18.5	18.5	14.6	19.3	17.8	17.1	17.6
9	25.5	27.3	27.1	26.9	27.1	32.4	26.5	24.9	25.0	21.9
10	23.0	35.1	27.5	39.1	27.5	30.4	28.5	27.9	24.3	25.8
11A	24.4	22.9	25.0	22.8	24.6	25.8	22.6	25.7	18.8	35.2
11B	25.3	16.4	32.6	38.0	28.5	25.3	24.7	28.5	25.3	24.7
12	20.9	25.3	22.7	24.3	23.5	25.2	22.0	24.0	21.8	24.4
13	32.9	28.6	33.8	27.5	31.6	26.0	27.0	26.0	26.9	26.5
14	30.1	29.1	31.7	27.9	28.3	27.9	28.7	28.5	30.7	27.9
15	43.3	48.6	48.6	49.9	48.0	47.2	49.5	48.5	48.3	49.8
16	61.4	57.3	63.6	60.7	63.1	57.6	59.5	59.5	65.4	56.0
17	32.8	26.8	28.1	28.1	27.7	28.2	27.4	25.5	28.3	26.9
18	47.0	50.9	47.0	50.9	48.1	50.9	46.1	50.9	48.3	52.1
19	28.0	22.6	28.5	27.2	27.9	27.8	26.8	26.6	22.1	24.3
20	56.7	53.3	60.8	54.5	60.8	53.3	63.9	55.8	62.3	55.8
21	33.6	32.3	33.6	35.0	34.5	31.5	33.6	34.1	32.0	31.5

[a]Va,Vb = average velocities of the clockwise and counterclockwise teams, respectively over each trip.

Table A-18. ESTIMATED VMT PER HOUR BY ROUTE TRIP

Route	Trip Number[a]				
	1	2	3	4	5
1X	2,650	2,800	2,930	3,180	1,740
2X	1,580	1,480	1,650	1,950	1,360
3X	2,130	2,830	2,150	2,590	1,890
5	589	636	726	943	822
6	599	597	568	915	420
7A	1,890	1,850	2,120	1,640	1,310
7B	739	627	535	364	561
8A	636	823	637	686	622
8B	367	366	294	241	486
9	620	648	753	847	525
10	1,170	1,580	1,370	1,580	1,180
11A	1,560	1,610	1,410	1,770	1,490
11B	119	158	174	106	38
12	1,020	1,340	1,280	1,470	1,150
13	1,190	864	1,280	1,140	734
14	917	979	1,220	1,100	745
15	664	271	452	686	539
16	860	590	693	1,010	1,240
17	973	1,240	1,440	1,390	952
18	538	367	519	726	326
19	1,560	2,020	1,920	1,800	1,040
20	714	575	511	447	677
21	1,480	1,780	1,810	1,680	1,600

[a]Numbers are rounded to 3-significant digits

Table A-19. TRAFFIC SURVEY STARTING TIMES FOR EACH TRIP FOR EACH ROUTE[a]

Route	Trip Number 1	2	3	4	5
1X	1030 (46)	1120 (46)	1325 (45)	1433 (48)	1546 (46)
2X	1017 (50)	1116 (55)	1318 (51)	1431 (55)	1546 (59)
3X	0959 (42)	1116 (44)	1319 (47)	1433 (50)	1545 (49)
5	1001 (40)	1115 (40)	1318 (38)	1418 (38)	1530 (39)
6	1024 (43)	1121 (45)	1319 (46)	1433 (48)	1544 (48)
7A	1026 (24)	1118 (26)	1323 (27)	1430 (28)	1546 (29)
7B	1026 (13)	1118 (16)	1323 (14)	1430 (19)	1546 (15)
8A	1008 (26)	1117 (22)	1341 (21)	1446 (22)	1545 (21)
8B	1008 (24)	1117 (26)	1341 (25)	1446 (28)	1545 (27)
9	0930 (51)	1045 (49)	1300 (45)	1416 (51)	1545 (56)
10	0940 (47)	1044 (41)	1306 (46)	1417 (47)	1550 (53)
11A	0931 (43)	1045 (42)	1300 (41)	1416 (43)	1545 (42)
11B	0931 (12)	1045 (7)	1300 (9)	1416 (9)	1545 (9)
12	1012 (58)	1128 (56)	1331 (54)	1431 (57)	1543 (58)
13	1007 (48)	1107 (48)	1324 (51)	1431 (55)	1546 (55)
14	1002 (45)	1100 (45)	1317 (48)	1431 (47)	1543 (46)
15	0953 (40)	1101 (38)	1303 (39)	1405 (38)	1500 (38)
16	1003 (35)	1102 (33)	1318 (34)	1435 (35)	1549 (34)
17	1012 (45)	1110 (48)	1322 (48)	1436 (51)	1548 (49)
18	1016 (44)	1115 (44)	1321 (43)	1447 (44)	1546 (43)
19	1001 (46)	1100 (48)	1319 (48)	1434 (50)	1545 (57)
20	1004 (44)	1100 (42)	1342 (43)	1430 (41)	1530 (41)
21	1004 (39)	1102 (37)	1319 (39)	1435 (38)	1551 (40)

[a]Numbers in parentheses represent trip duration in minutes, clock times on 24-hour system.

Table A-20. ESTIMATED VMT COUNTED DURING SURVEY TRIPS BY ROUTE BY TRIP

Route	Trip Number[a]					Totals by Route
	1	2	3	4	5	
1X	2,040	2,150	2,200	2,540	1,330	10,300
2X	1,320	1,360	1,400	1,790	1,340	7,200
3X	1,490	2,080	1,680	2,160	1,550	8,960
5	393	424	459	613	534	2,420
6	429	448	435	732	356	2,380
7A	756	802	956	767	633	3,910
7B	160	167	125	115	140	708
8A	276	302	223	251	218	1,270
8B	147	159	122	112	219	759
9	527	529	564	720	490	2,830
10	914	1,080	1,050	1,240	1,040	5,320
11A	1,120	1,130	964	1,270	1,050	5,520
11B	24	18	26	16	6	90
12	985	1,250	1,150	1,400	1,110	5,890
13	955	691	1,090	1,040	673	4,450
14	688	735	978	862	571	3,830
15	443	172	294	434	342	1,680
16	501	325	392	590	701	2,510
17	730	989	1,150	1,180	777	4,830
18	394	269	372	532	233	1,800
19	1,200	1,610	1,540	1,500	990	6,840
20	524	402	366	305	463	2,060
21	963	1,100	1,180	1,060	1,070	5,370
TOTAL						90,900

[a]Number rounded to 3-significant digits

Table A-21. DURATION OF PERIODS BETWEEN SURVEY TRIPS BY ROUTE BY GAP NUMBER

Route	Gap Number			
	1	2	3	4
1X	4	79	23	25
2X	9	67	22	20
3X	35	79	27	22
5	34	83	22	33
6	14	73	28	23
7A	28	99	40	48
7B	39	109	53	57
8A	43	122	44	37
8B	45	118	40	31
9	24	86	31	38
10	17	101	25	46
11A	31	93	35	46
11B	62	72	67	80
12	38	67	6	15
13	12	89	16	20
14	13	92	26	25
15	28	84	23	17
16	24	103	43	39
17	13	84	26	21
18	15	82	43	15
19	13	91	27	21
20	12	120	5	19
21	19	100	37	38

[a]Gap 1 represents duration (in minutes) between Trips 1 and 2, Gap 2 represents duration between Trips 3 and 4, etc.

Table A-22. ESTIMATED VMT DURING SURVEY GAPS BY ROUTE BY GAP NUMBER

Route	Gap Number [a]				Totals by Route
	1	2	3	4	
1X	182	3,780	1,170	1,020	6,150
2X	229	1,750	660	553	3,190
3X	1,450	3,280	1,070	822	6,620
5	347	941	306	485	2,080
6	140	709	346	256	1,450
7A	873	3,280	1,260	1,180	6,590
7B	444	1,050	397	439	2,330
8A	523	1,480	485	403	2,900
8B	275	649	178	188	1,290
9	254	1,000	413	435	2,100
10	389	2,490	615	1,060	4,550
11A	819	2,340	927	1,250	5,340
11B	143	199	156	96	595
12	746	1,460	137	328	2,670
13	206	1,590	323	312	2,430
14	205	1,690	503	385	2,780
15	218	506	218	174	1,120
16	290	1,100	611	731	2,730
17	239	1,870	612	409	3,130
18	113	605	446	131	1,300
19	388	2,990	838	498	4,710
20	129	1,090	40	178	1,430
21	517	2,990	1,070	1,040	5,620
TOTAL					73,100

[a]Number rounded to 3-significant digits

Table A-23. HOURLY FRACTION OF DAILY TRAFFIC BY AXLE CLASS[a]

Hour of Day	2-Axle	3-Axle	4-Axle	5+Axle	Truck Total
24-1	.01	.02	.02	.04	.03
1-2	.01	.01	.02	.04	.03
2-3	.01	.02	.02	.04	.03
3-4	.01	.02	.02	.04	.03
4-5	.01	.02	.02	.05	.05
5-6	.02	.03	.02	.05	.04
6-7	.04	.05	.05	.04	.04
7-8	.06	.05	.05	.03	.04
8-9	.07	.08	.05	.03	.05
9-10	.08	.06	.05	.04	.05
10-11	.07	.06	.07	.04	.05
11-12	.07	.06	.05	.04	.05
12-13	.06	.06	.07	.05	.05
13-14	.07	.06	.07	.05	.06
14-15	.08	.06	.07	.05	.06
15-16	.08	.06	.07	.05	.06
16-17	.08	.06	.05	.04	.05
17-18	.05	.06	.05	.04	.05
18-19	.04	.04	.04	.04	.04
19-20	.03	.03	.03	.04	.04
20-21	.02	.03	.03	.04	.03
21-22	.01	.02	.03	.04	.03
22-23	.01	.02	.03	.04	.03
23-24	.01	.02	.02	.04	.03
24-Hour Total	1.00	1.00	1.00	1.00	1.00

[a]Source: CALTRANS, 1967

Table A-24. ESTIMATION OF DAILY VEHICLE MILES TRAVELED (DVMT) BY ROUTE[a]

Route	VMT Counted During Survey Trips	VMT Estimated During Survey Gaps	Total VMT For Survey Period	% of Daily Total	Estimated 24-Hour DVMT
1X	10,300	6,150	16,400	43.8	37,500
2X	7,200	3,190	10,400	47.0	22,100
3X	8,960	6,620	15,600	47.7	32,700
5	2,420	2,080	4,500	44.1	10,200
6	2,380	1,450	3,830	44.5	8,610
7A	3,910	6,590	10,500	42.0	25,000
7B	708	2,330	3,040	40.1	7,590
8A	1,270	2,900	4,170	42.9	9,710
8B	759	1,290	2,050	43.7	4,690
9	2,830	2,100	4,940	52.5	9,400
10	5,320	4,550	9,870	51.4	19,200
11A	5,520	5,340	10,900	50.5	21,500
11B	90	595	685	46.1	1,480
12	5,890	2,670	8,560	47.1	18,200
13	4,450	2,430	6,890	47.7	14,400
14	3,830	2,780	6,620	46.6	14,200
15	1,860	1,120	2,800	41.0	6,830
16	2,510	2,730	5,240	45.7	11,500
17	4,830	3,130	7,960	46.5	17,100
18	1,800	1,300	3,100	45.0	6,880
19	6,840	4,710	11,500	48.5	23,800
20	2,060	1,430	3,490	44.0	7,940
21	5,370	5,620	11,000	46.7	23,500
TOTALS	90,900	73,100	164,000		354,000

[a]Numbers rounded to 3-significant digits

Table A-25. ESTIMATION OF DVMT PER MILE BY ROUTE [a]

Route	DVMT	Mileage	DVMT/Mile
1X	37,500	20.5	1,830
2X	22,100	22.0	1,000
3X	32,700	20.6	1,590
5	10,200	17.8	574
6	8,610	21.0	410
7A	25,000	13.0	1,920
7B	7,590	7.8	973
8A	9,710	11.7	830
8B	4,690	8.0	586
9	9,400	21.9	429
10	19,200	21.9	877
11A	21,500	17.1	1,260
11B	1,480	3.8	391
12	18,200	22.0	826
13	14,400	24.3	594
14	14,200	22.0	645
15	6,830	30.6	223
16	11,500	34.2	335
17	17,100	22.3	768
18	6,880	35.5	194
19	23,800	22.0	1,080
20	7,940	40.3	197
21	23,500	21.2	1,110

[a]Numbers rounded to 3-significant digits.

Table A-26. ESTIMATED DVMT PER MILE BY NUMBER OF AXLES AND FUNCTIONAL CLASSIFICATION

No. of Axles	DVMT/Mile[a]		
	PA	MA	MJC
2	770	445	123
3	160	86	29
4	33	13	9
5+	163	54	76
TOTAL	1,130	598	237

[a]Numbers rounded to 3-significant digits.

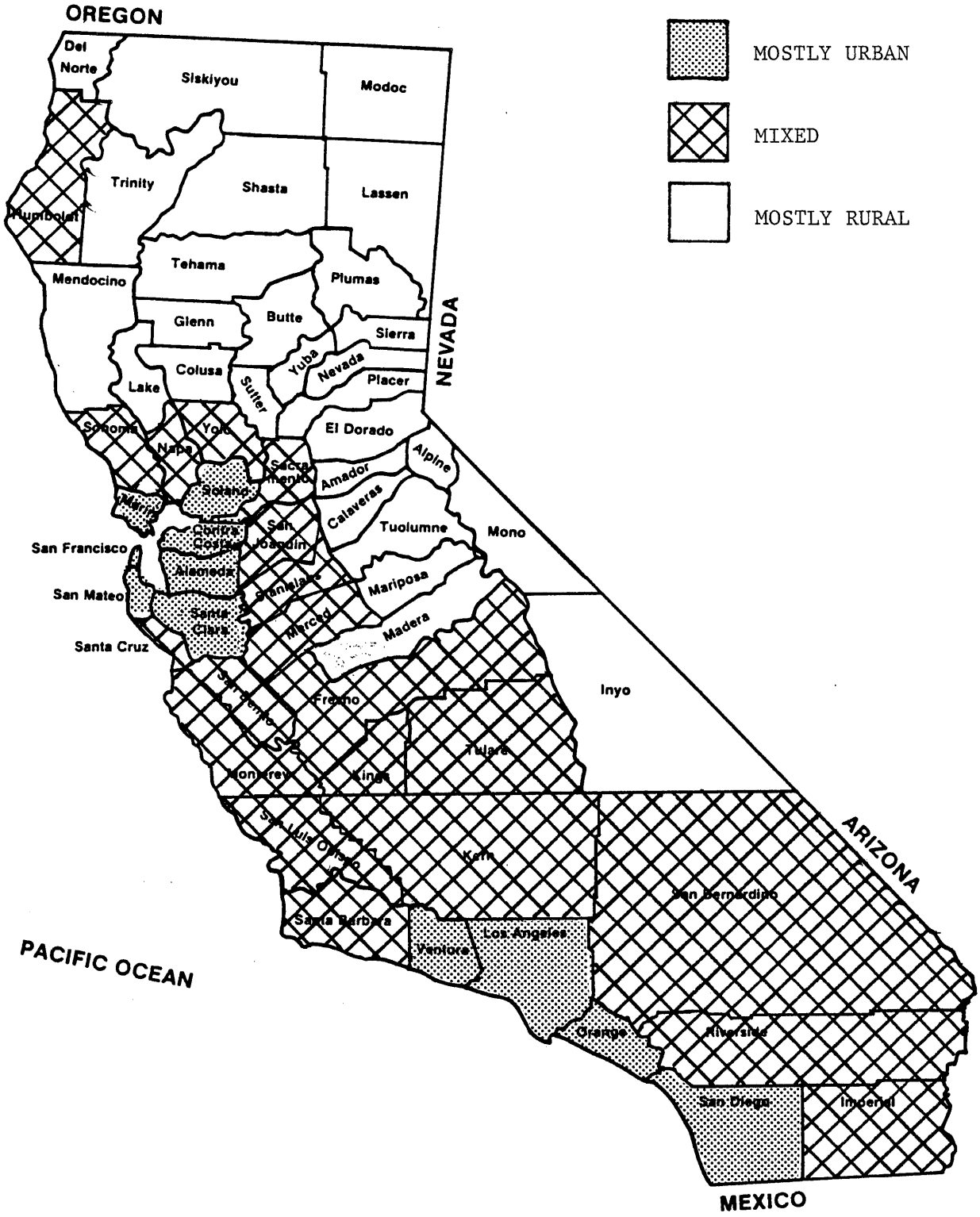
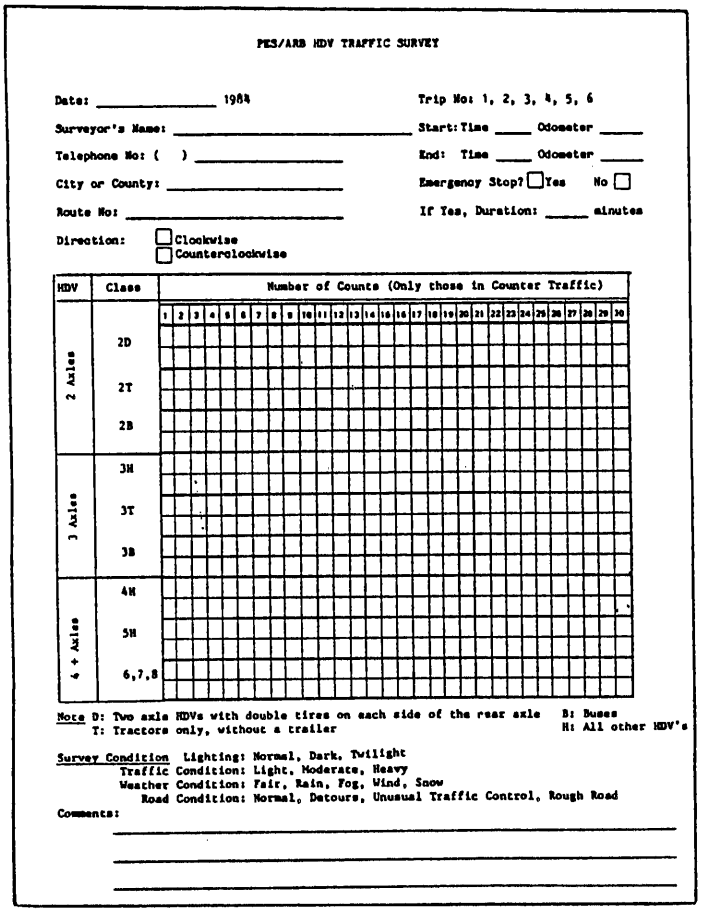


Figure A-1. Geographic Distribution of County Groups

1. Carson*
2. Anahiem/Garden Grove*
3. San Fernando Valley*
4. Pico Rivera**
5. Northridge
6. Garden Grove
7. San Diego/Miramar
8. San Diego/Downtown
9. Redwood City
10. Sunnyvale
11. San Francisco
12. Oakland
13. San Bernardino
14. Riverside
15. Riverside County (Hemet Valley)
16. Kern County (Shafter/Wasco)
17. Bakersfield
18. Stockton
19. Sacramento
20. Fresno County
21. Fresno

* Pilot and Full Surveys
** Pilot Survey only

Figure A-2. Location of Traffic Survey Routes



PES/ARB HDV TRAFFIC SURVEY

Date: _____ 1984

Surveyor's Name: _____

Telephone No: ( ) _____

City or County: _____

Route No: _____

Direction: ☐ Clockwise ☐ Counterclockwise

Trip No: 1, 2, 3, 4, 5, 6

Start: Time ____ Odometer ____

End: Time ____ Odometer ____

Emergency Stop? ☐ Yes No ☐

If Yes, Duration: _____ minutes

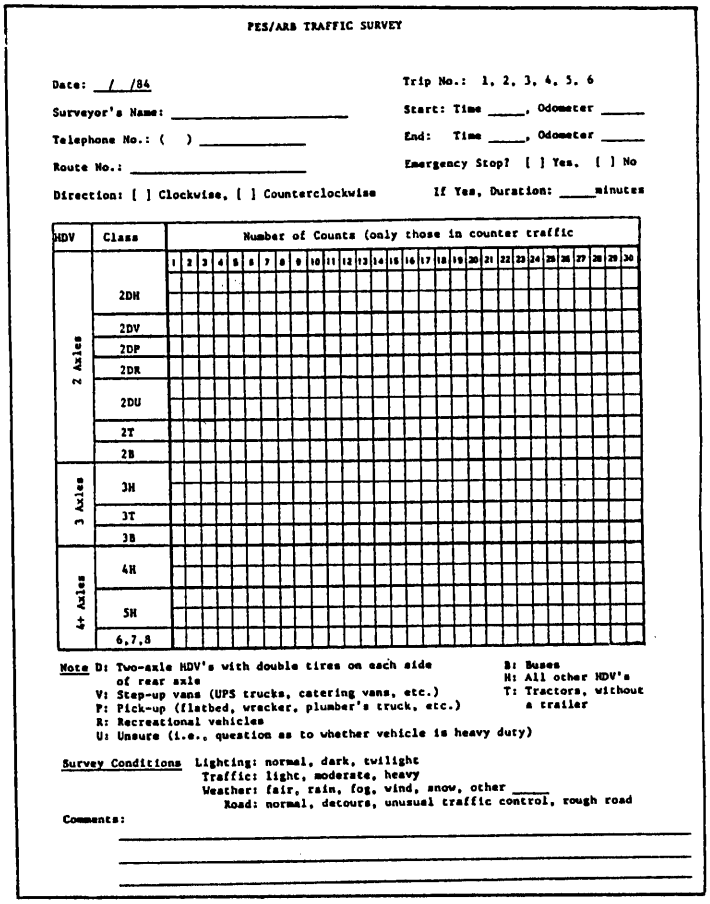
HDV	Class	Number of Counts (Only those in Counter Traffic)
2 Axles	2D	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
	2T	
	2B	
3 Axles	3H	
	3T	
	3B	
4 + Axles	4H	
	5H	
	6,7,8	

Note D: Two axle HDVs with double tires on each side of the rear axle
T: Tractors only, without a trailer
B: Buses
H: All other HDV's

Survey Condition Lighting: Normal, Dark, Twilight
Traffic Condition: Light, Moderate, Heavy
Weather Condition: Fair, Rain, Fog, Wind, Snow
Road Condition: Normal, Detours, Unusual Traffic Control, Rough Road

Comments: _____

Form 1



PES/ARB TRAFFIC SURVEY

Date: / /84

Surveyor's Name: _____

Telephone No.: ( ) _____

Route No.: _____

Direction: [ ] Clockwise, [ ] Counterclockwise

Trip No.: 1, 2, 3, 4, 5, 6

Start: Time ____, Odometer ____

End: Time ____, Odometer ____

Emergency Stop? [ ] Yes, [ ] No

If Yes, Duration: ____minutes

HDV	Class	Number of Counts (only those in counter traffic
2 Axles	2DH	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
	2DV	
	2DP	
	2DR	
	2DU	
	2T	
	2B	
3 Axles	3H	
	3T	
	3B	
4+ Axles	4H	
	5H	
	6,7,8	

Note D: Two-axle HDV's with double tires on each side of rear axle
V: Step-up vans (UPS trucks, catering vans, etc.)
P: Pick-up (flatbed, wracker, plumber's truck, etc.)
R: Recreational vehicles
U: Unsure (i.e., question as to whether vehicle is heavy duty)
B: Buses
H: All other HDV's
T: Tractors, without a trailer

Survey Conditions Lighting: normal, dark, twilight
Traffic: light, moderate, heavy
Weather: fair, rain, fog, wind, snow, other ____
Road: normal, detours, unusual traffic control, rough road

Comments: _____

Form 2

Figure A-3. Traffic Survey Forms Used for Pilot Survey

PES/ARB TRAFFIC SURVEY

Date: ___/___/84

Surveyor's Name: _____

Route No.: _____

Direction: [ ] Clockwise, [ ] Counterclockwise

Emergency Stop? [ ] Yes, [ ] No

If yes, duration: _____ minutes

Trip No.: 1, 2, 3, 4, 5, 6

Street	Part	Time	Odometer
	(End)		

HDV Class	Part A																		Part B												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2H																																		
2B																																		
2V																																		
2PF																																		
2PC																																		
2PB																																		
2W																																		
2MH																																		
2MB																																		
2T																																		
2CV																																		
3H																																		
3B																																		
3T																																		
4H																																		
5H																																		
6,7,8																																		

Note H: Heavy-duty trucks
B: Large buses (municipal, school)
V: Step-up vans (UPS. catering trucks, etc.)
PF: Pick-ups with or without flatbed
PC: Pick-ups with camper shell
PB: Pick-ups with box cargo space
W: Wreckers (tow trucks)
MB: Mini-buses and wagons
MH: Motor homes
T: Tractor only (without trailer)
CV: Cut-away van with box cargo space, and van camper

Survey Conditions Lighting: normal, dark, twilight
Traffic: light, moderate, heavy
Weather: fair, rain, fog, wind, snow, other _____
Road: normal, detours, unusual traffic control, rough road

Comments: _____

Figure A-4. Traffic Survey Form Used for Full Survey

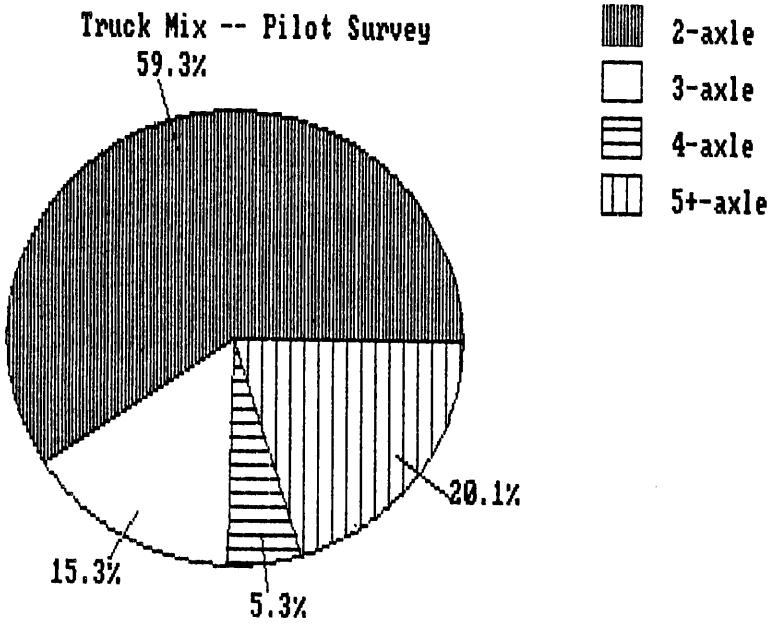


Figure A-5. Truck Mix Determined by the Pilot Survey on Four Urban Principal Arterial Routes

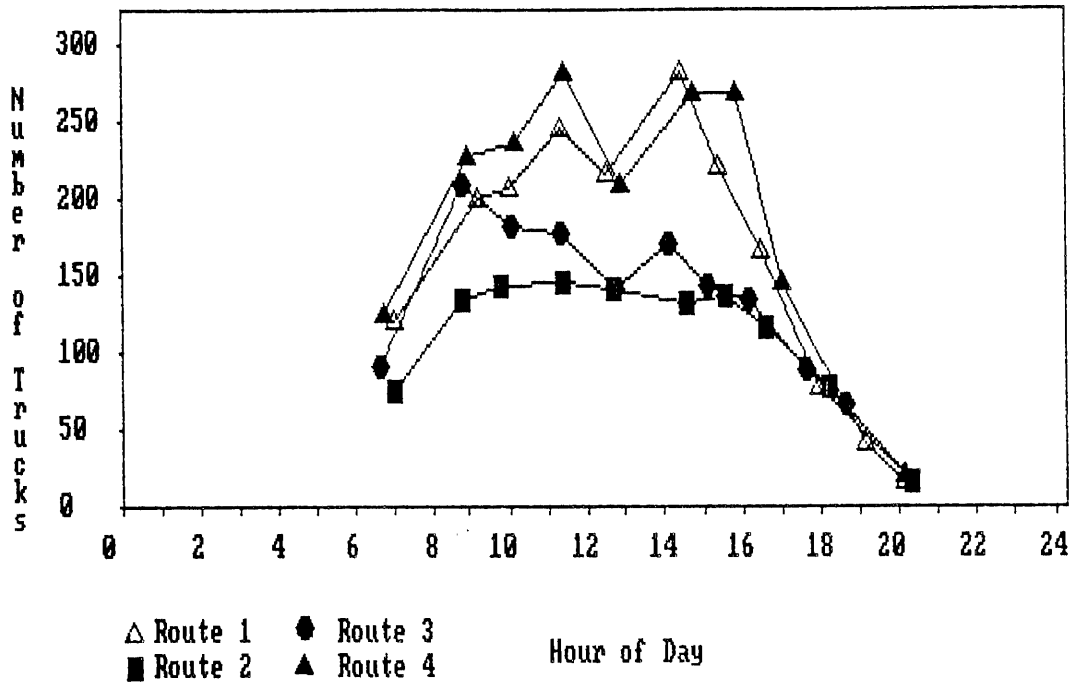


Figure A-6. Diurnal Variations of Truck Traffic Volumes Observed During the Pilot Survey

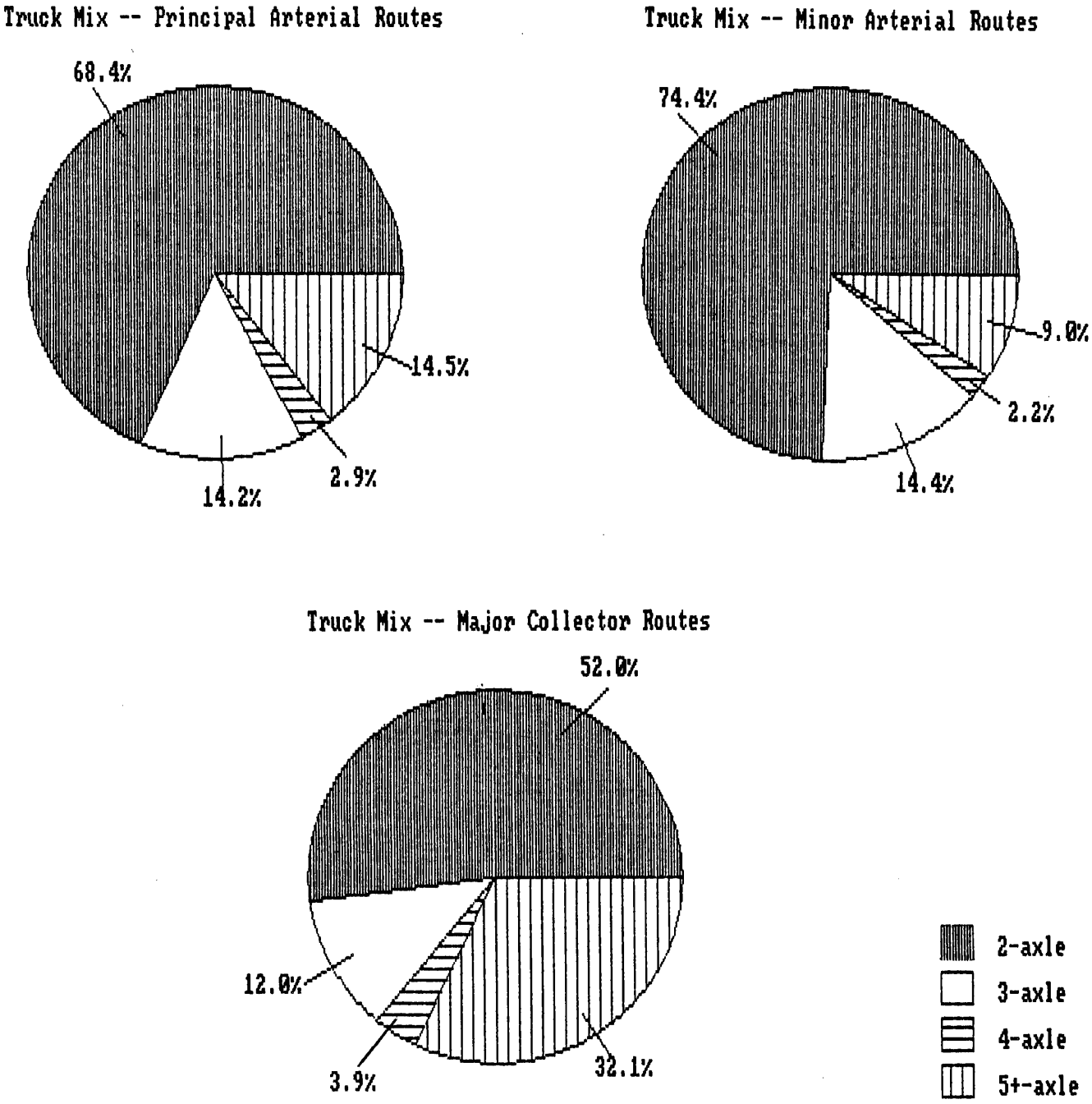


Figure A-7. Average Truck Mix Determined by the Survey for Each of Three Functional Classes

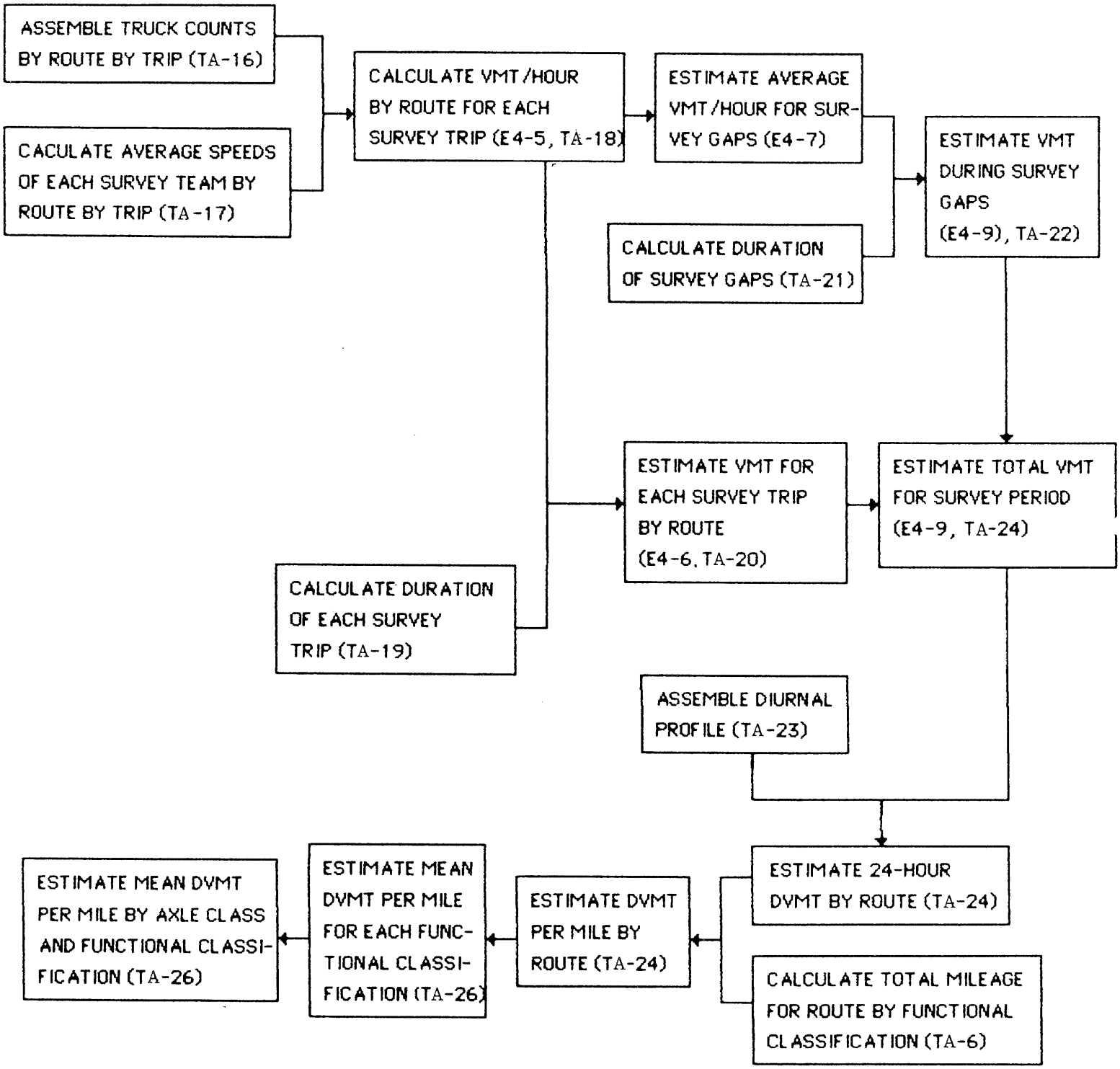


Figure A-8. Logic Diagram Used to Estimate Daily Truck VMT from the Traffic Survey

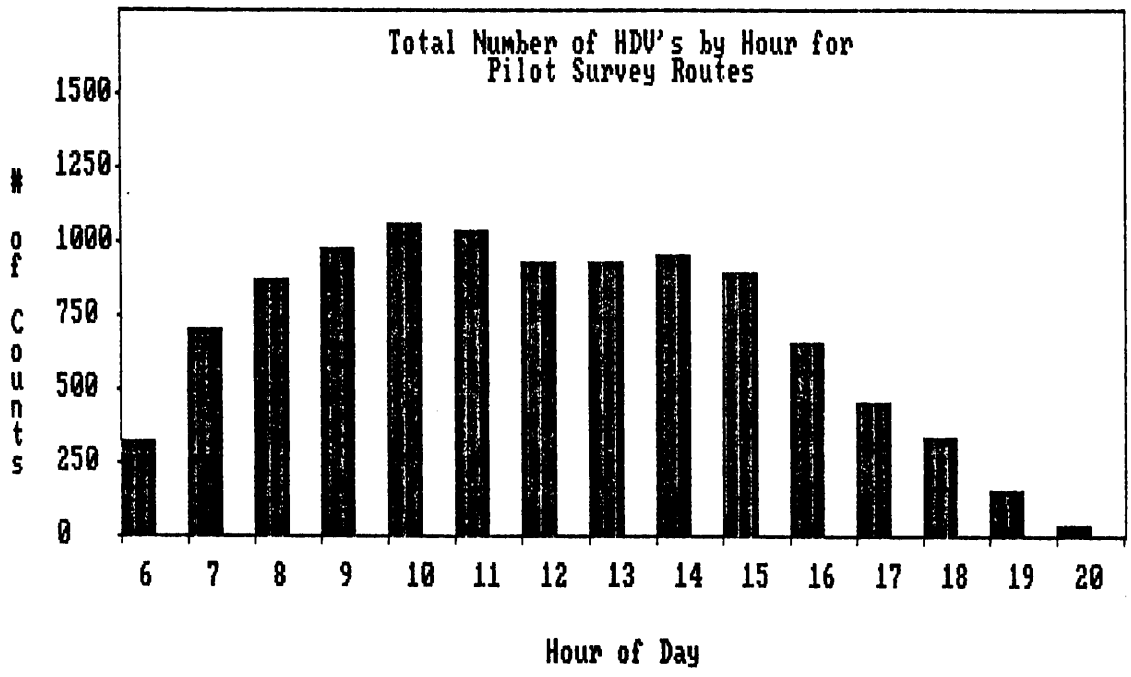


Figure A-9. Diurnal Profile of Hourly Truck Traffic Volume Determined by the Pilot Survey

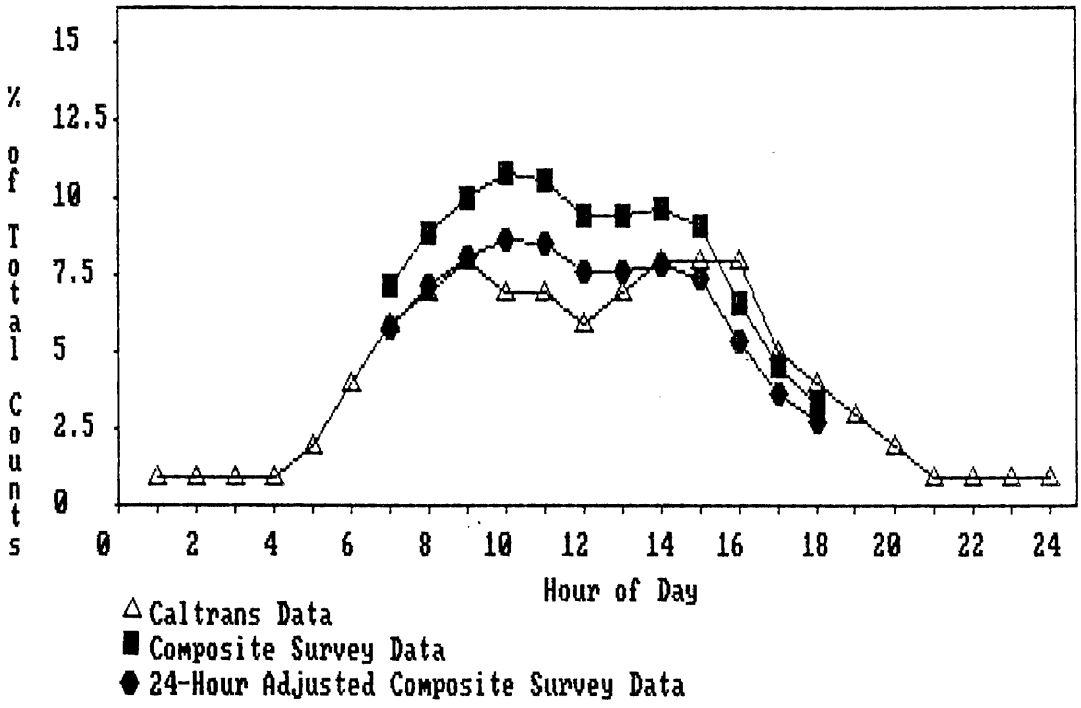


Figure A-10. Diurnal Profiles of Hourly Truck Traffic Volume, Determined by CALTRANS and by PES Pilot Survey

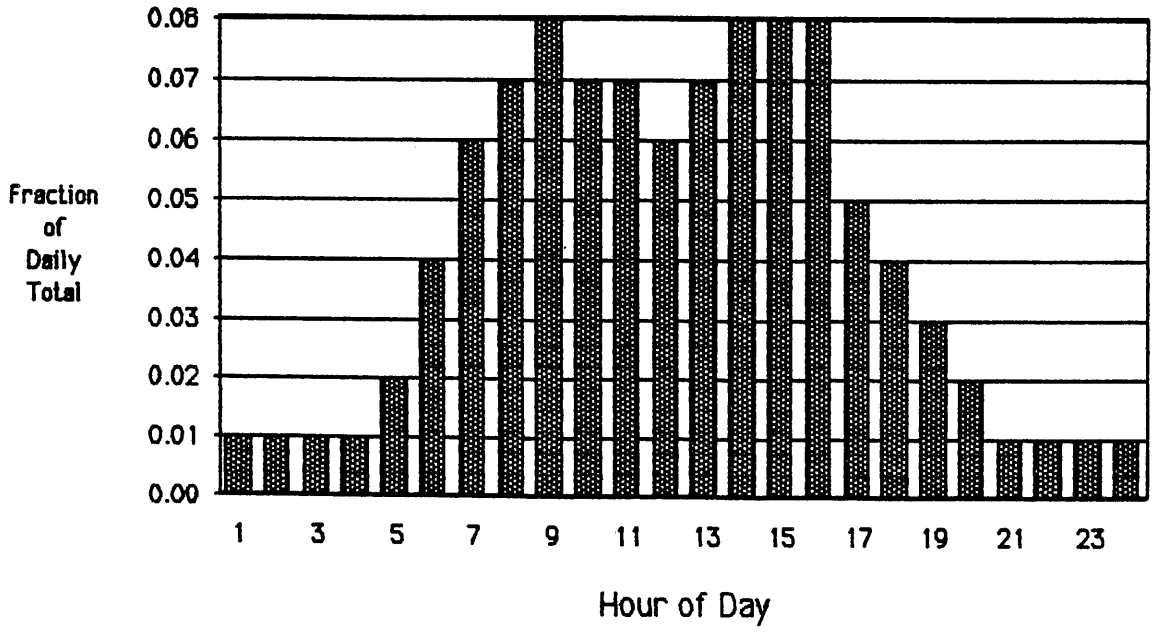


Figure A-11. Normalized Diurnal Profile of Hourly Truck Traffic Volume (after CALTRANS 1967)

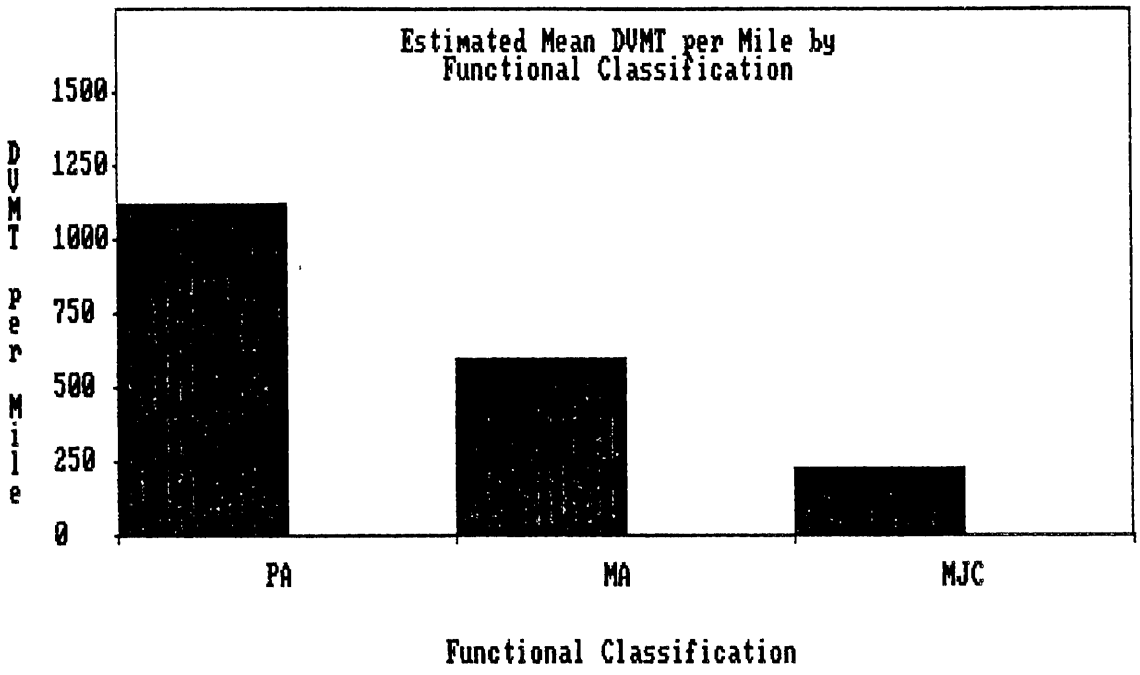


Figure A-12. Estimated Daily Truck VMT Densities for Three Functional Classes

APPENDIX B

SELECTED ROUTES FOR THE PES SPECIAL TRUCK TRAFFIC SURVEY

This appendix contains detailed maps of the routes used for the pilot and full traffic surveys. The methods of route selection are discussed in Section A.2.2 of Appendix A. Maps for Routes 1 through 21 provide indications of functional classification for each street section over which the surveys took place. Mileage of each functional class section is also given on the maps. Symbols used on the maps are defined as follows:

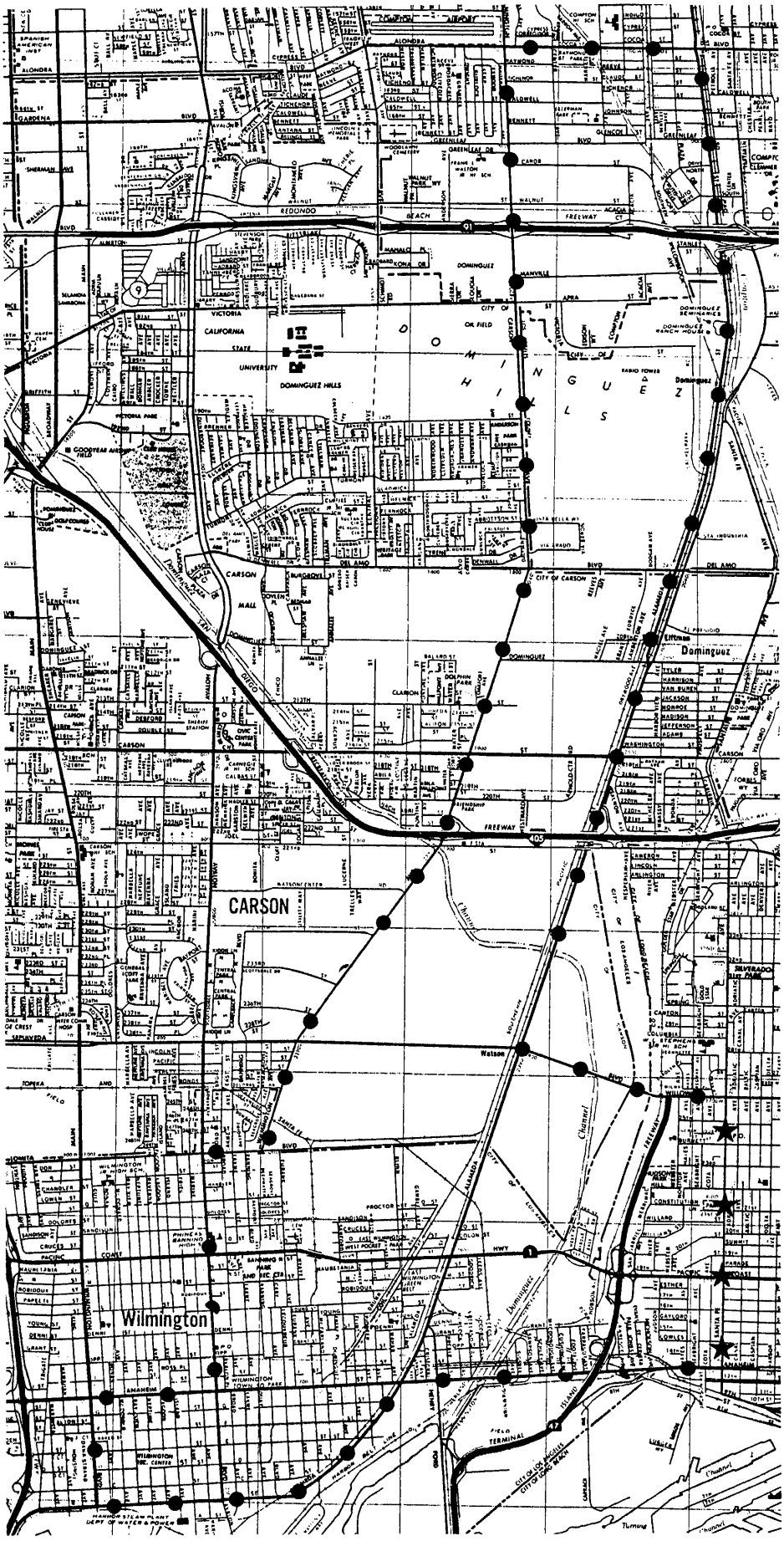
- ● Principal Arterial
- ■ Minor Arterial
- ▲ Major Collector
- ✦ Do not count trucks over this section

Table B-1. SPECIFICATIONS OF ROUTES USED IN THE PILOT AND FULL TRAFFIC SURVEYS

Route Code	Location	County Type[a]	Functional Classification[b]	Mileage	Survey Type P=Pilot, F=Full
1	Carson	LA/U	PA	20.9	P
1X	Carson	LA/U	PA	20.5	F
2	Garden Grove	OR/U	PA	22.0	P
2X	Garden Grove	OR/U	PA	22.0	F
3	San Fernando Valley	LA/U	PA	20.6	P
3X	San Fernando Valley	LA/U	PA	20.6	F
4	Pico Rivera	LA/U	PA	22.2	P
5	Northridge	LA/U	MA	17.8	F
6	Garden Grove	OR/U	MA	21.0	F
7A	San Diego/Miramar	SD/U	PA	13.0	F
7B	San Diego/Miramar	SD/U	MA	7.8	F
8A	San Diego/Downtown	SD/U	PA	11.7	F
8B	San Diego/Downtown	SD/U	MA	8.0	F
9	Redwood City	SM/U	MA	21.9	F
10	Sunnyvale	SCL/U	PA	21.9	F
11A	San Francisco	SF/U	PA	17.1	F
11B	San Francisco	SF/U	MA	3.8	F
12	Oakland	AL/U	MA	22.0	F
13	San Bernardino	SBDO/M	PA	24.3	F
14	Riverside	RIV/M	PA	22.2	F
15	Riverside County	RIV/M	MJC	30.6	F
16	Kern County	K/M	MJC	34.2	F
17	Bakersfield	K/M	PA	22.3	F
18	Stockton	SJ/M	MJC	35.5	F
19	Sacramento	SAC/M	PA	22.0	F
20	Fresno County	F/M	MJC	40.3	F
21	Fresno	F/M	PA	21.2	F

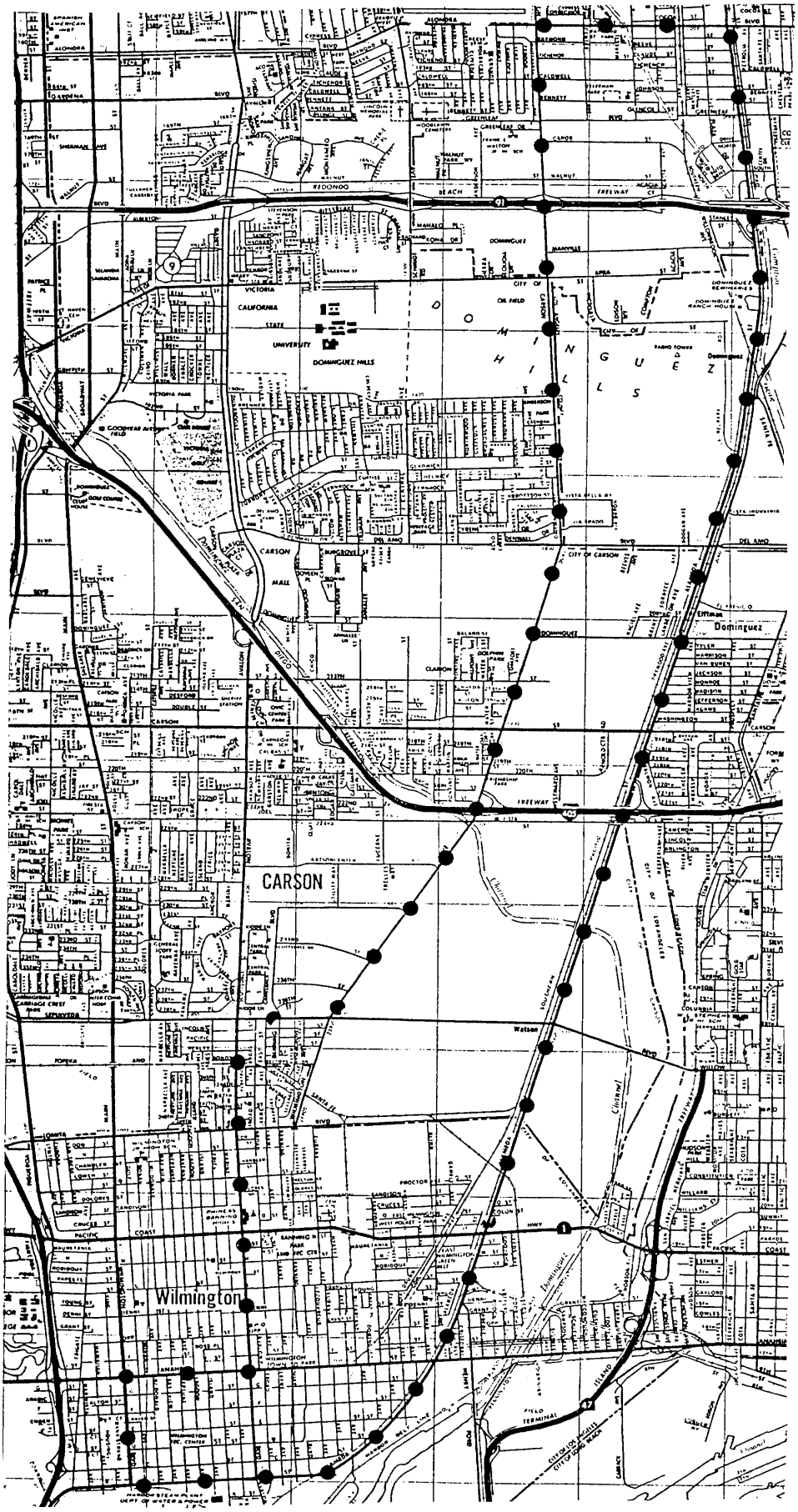
[a] U = urban county, M = mixed county as defined by Table A-3

[b] PA = principal arterial, MA = minor arterial, MJC = major collector


CARSON
Wilmington
Dominguez
DOMINGUEZ HILLS
CALIFORNIA STATE UNIVERSITY
Watson
Channel

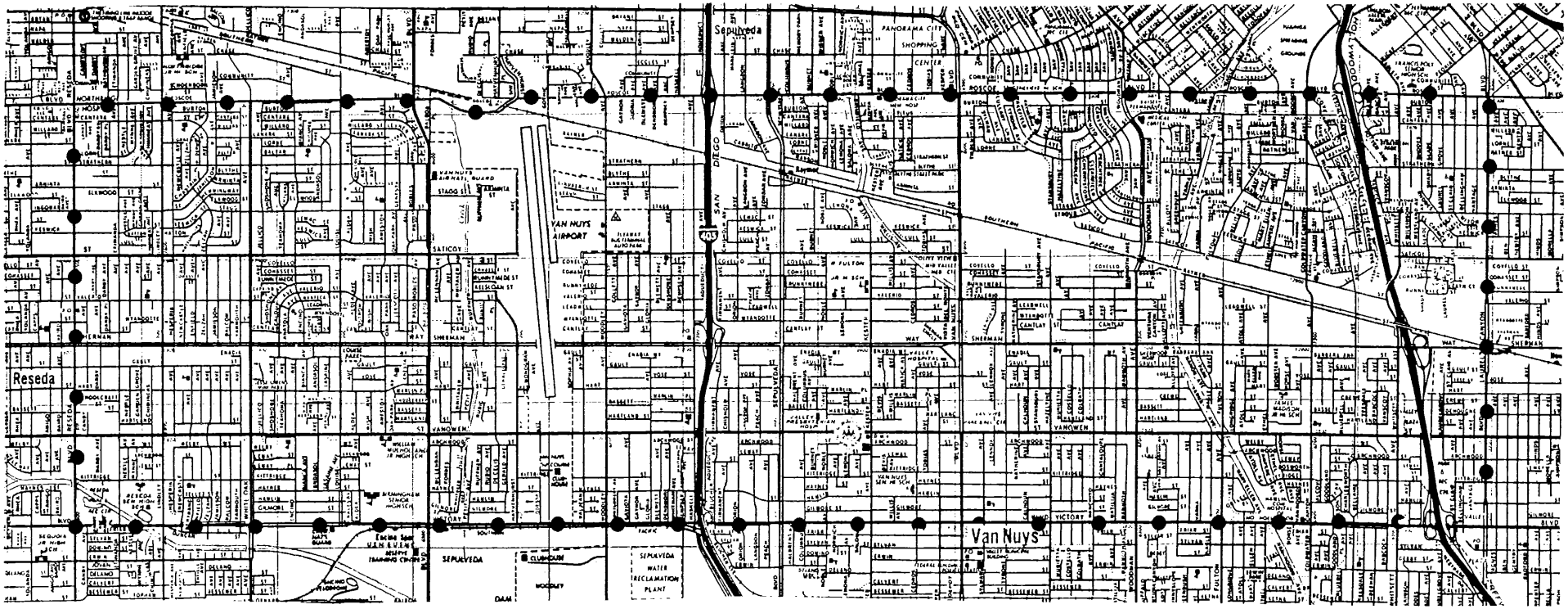
ROUTE 1

B-3

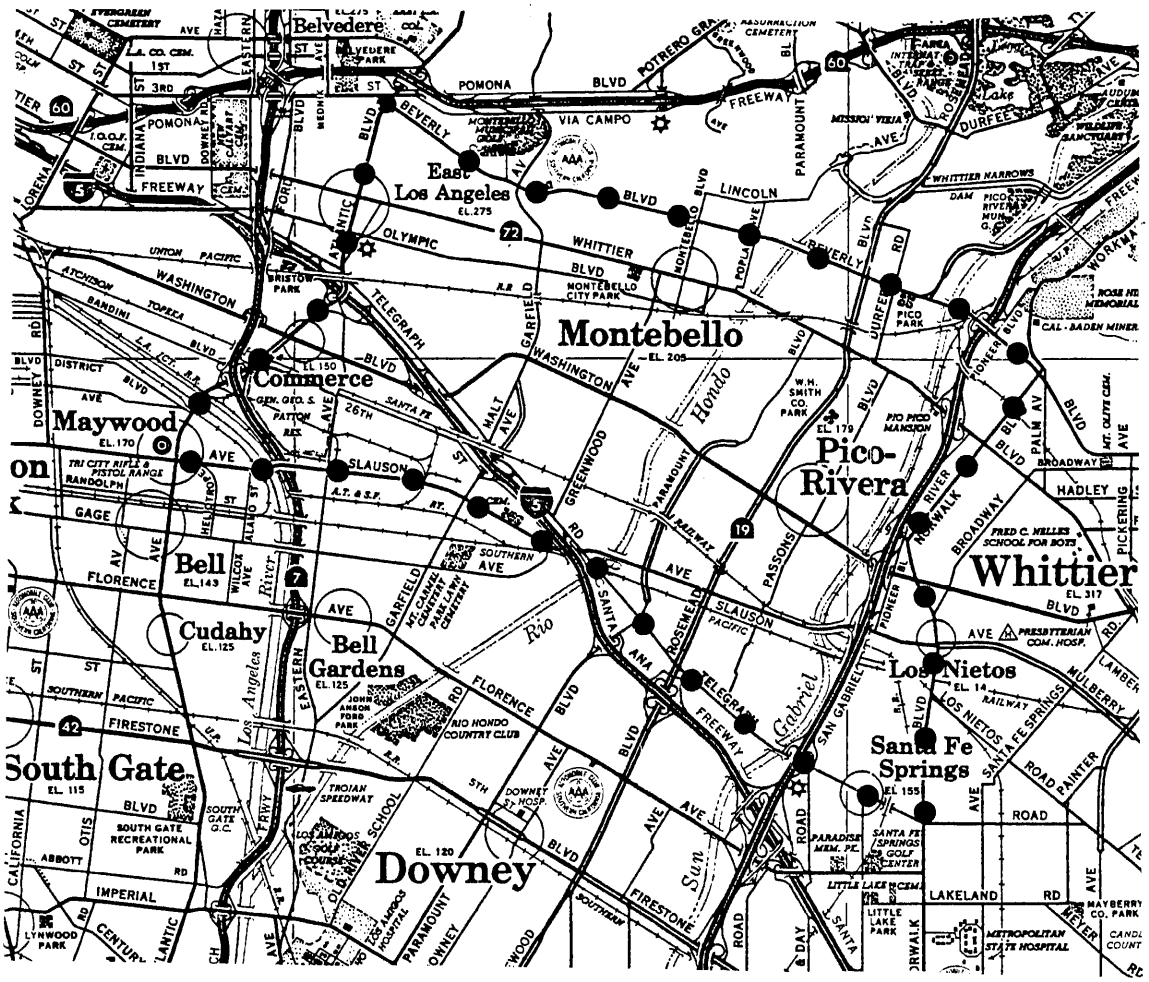

CARSON
Wilmington
Dominguez
DOMINGUEZ HILLS
CALIFORNIA STATE UNIVERSITY
CARSON MALL
Watson

ROUTE 1X
B-4

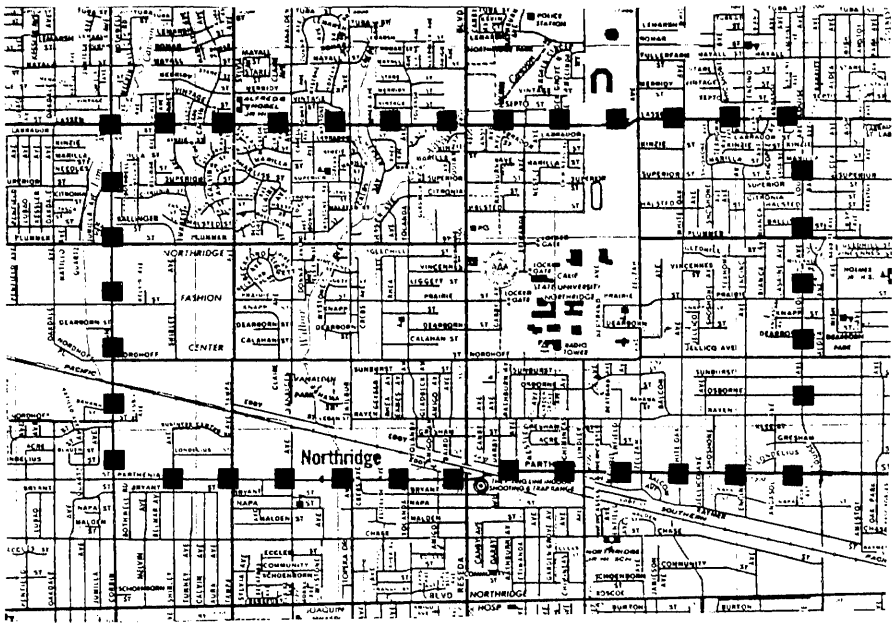
ROUTES 2 AND 2X



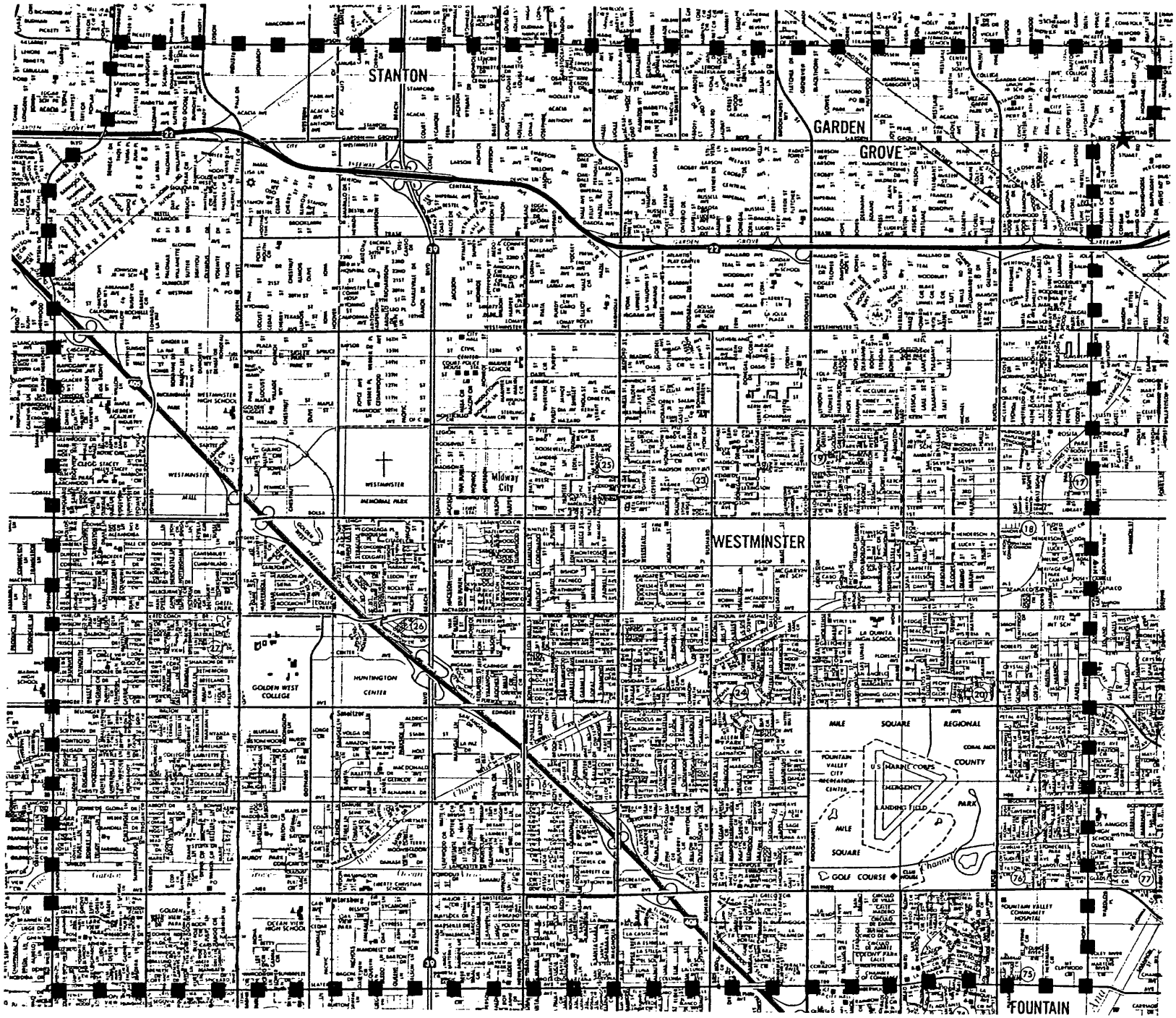
ROUTES 3 AND 3X


Belvedere
East Los Angeles
Montebello
Commerce
Maywood
Bell
Cudahy
Bell Gardens
South Gate
Downey
Pico-Rivera
Whittier
Los Nietos
Santa Fe Springs
POMONA BLVD
FREEWAY
VIA CAMPO
BEVERLY
LINCOLN
OLYMPIC
WHITTIER BLVD
WASHINGTON
TELEGRAPH
SLAUSON
FLORENCE
FIRESTONE
IMPERIAL
GREENWOOD
PARAMOUNT
SOUTHERN PACIFIC
Rio Hondo
Los Angeles River
San Gabriel
LAKELAND RD
BROADWAY
HADLEY
PICKERING
MULBERRY
LAMBERT
SANTA FE SPRINGS ROAD
PAINTER
ROSEMEAD
SANTA ANA
GARFIELD
ATLANTIC
EASTERN
PASSONS
SAN GABRIEL
DOWNEY
OTIS
CALIFORNIA
ABBOTT
CENTURY
LYNWOOD PARK
SOUTH GATE RECREATIONAL PARK
TROJAN SPEEDWAY
RIO HONDO COUNTRY CLUB
JOHN ANSON FORD PARK
PICO PARK
PICO MANSION
W.H. SMITH CO. PARK
MONTEBELLO CITY PARK
BRISTOW PARK
WHITTIER NARROWS DAM
PRESBYTERIAN COM. HOSP.
METROPOLITAN STATE HOSPITAL
LITTLE LAKE PARK
SANTA FE SPRINGS GOLF CENTER
PARADISE MEM. PK.
MAYBERRY CO. PARK
FRED C. NELLES SCHOOL FOR BOYS
CAL-BADEN MINER.
EVERGREEN CEMETERY
RESURRECTION CEMETERY
MT. CARMEL CEMETERY
MT. CALVARY CEMETERY
L.A. CO. CEM.
I.O.O.F. CEM.
TRI CITY RIFLE & PISTOL RANGE
GEN. GEO. S. PATTON REC.
EL. 275
EL. 205
EL. 150
EL. 170
EL. 143
EL. 125
EL. 115
EL. 120
EL. 179
EL. 317
EL. 155

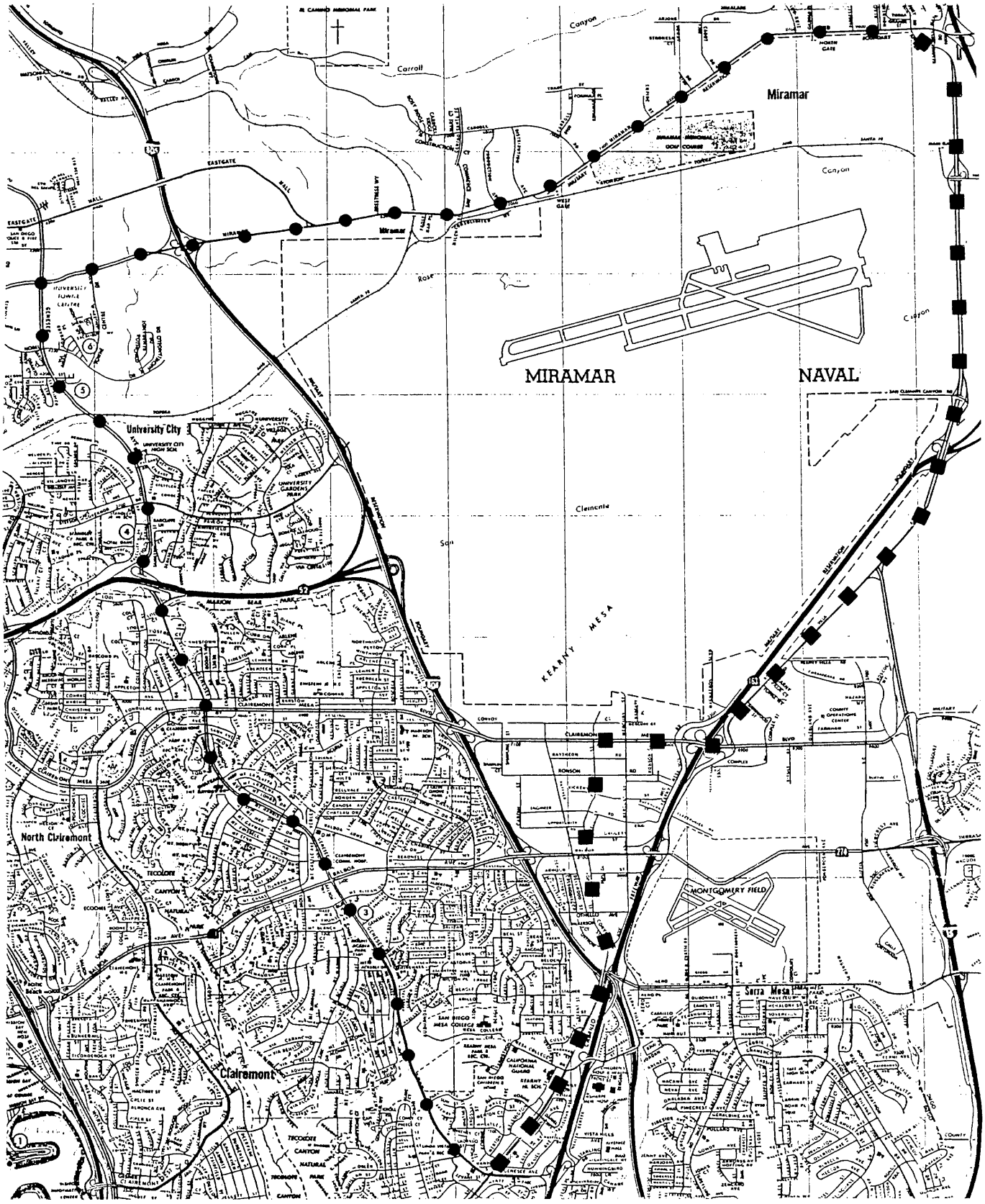
ROUTE 4



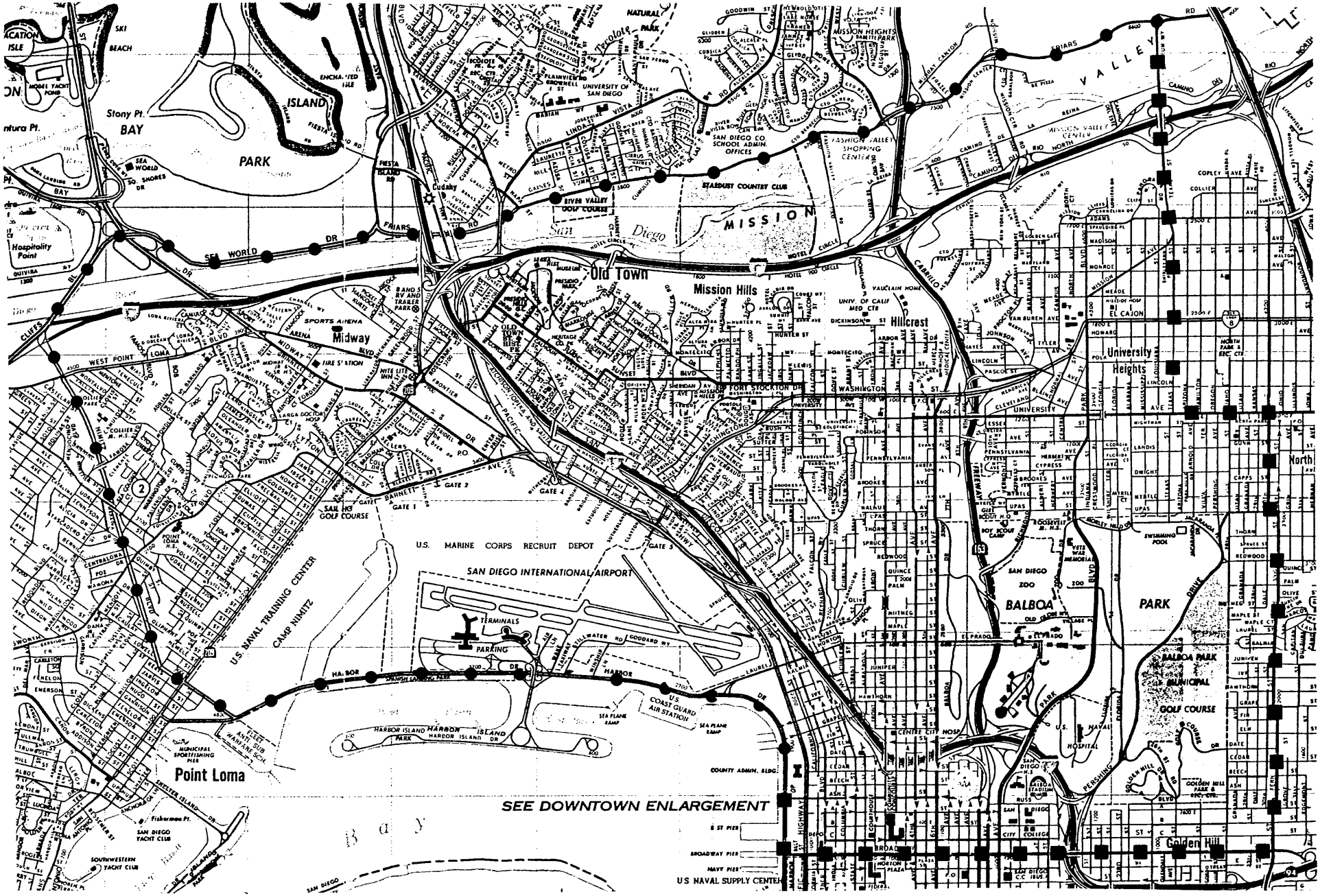
ROUTE 5


STANTON
GARDEN GROVE
WESTMINSTER
Midway City
WESTMINSTER MEMORIAL PARK
GOLDEN WEST COLLEGE
HUNTINGTON CENTER
MILE SQUARE REGIONAL COUNTY PARK
GOLF COURSE
FOUNTAIN

ROUTE 6



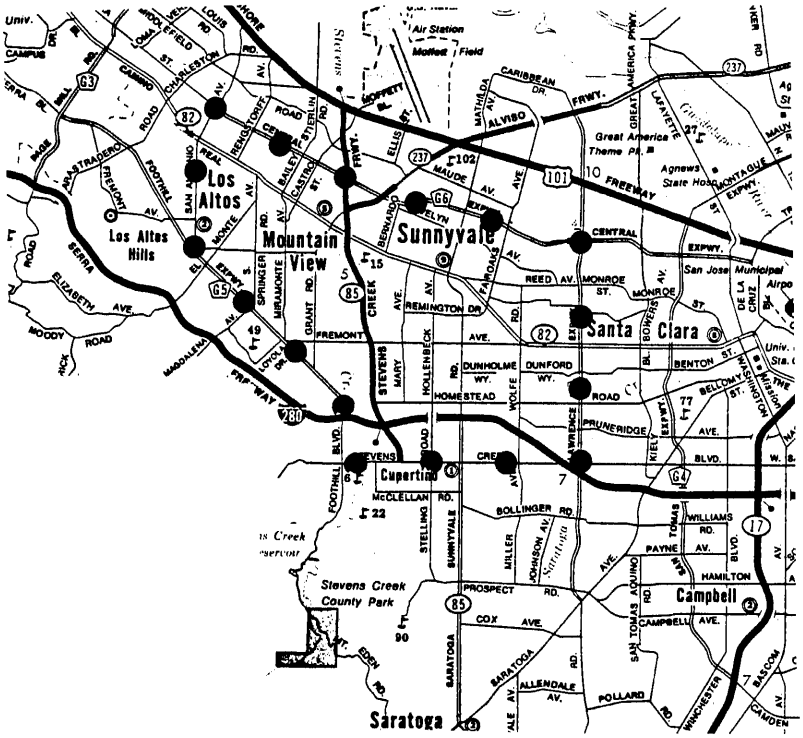
ROUTES 7A AND 7B



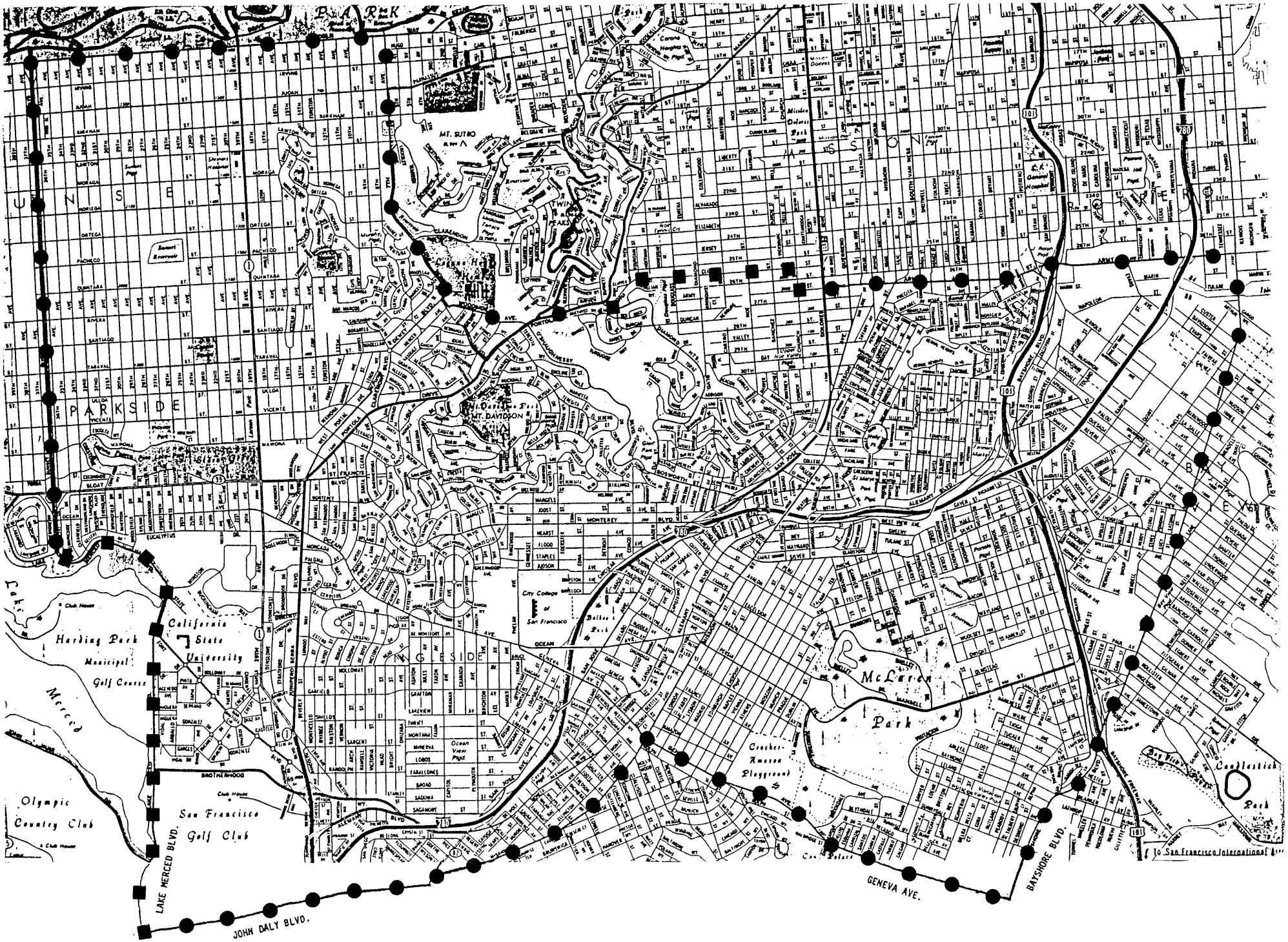
ROUTES 8A AND 8B

REDWOOD SHORES
SAN FRANCISCO BAY
SAN CARLOS
REDWOOD CITY
MENLO PARK
ATHERTON

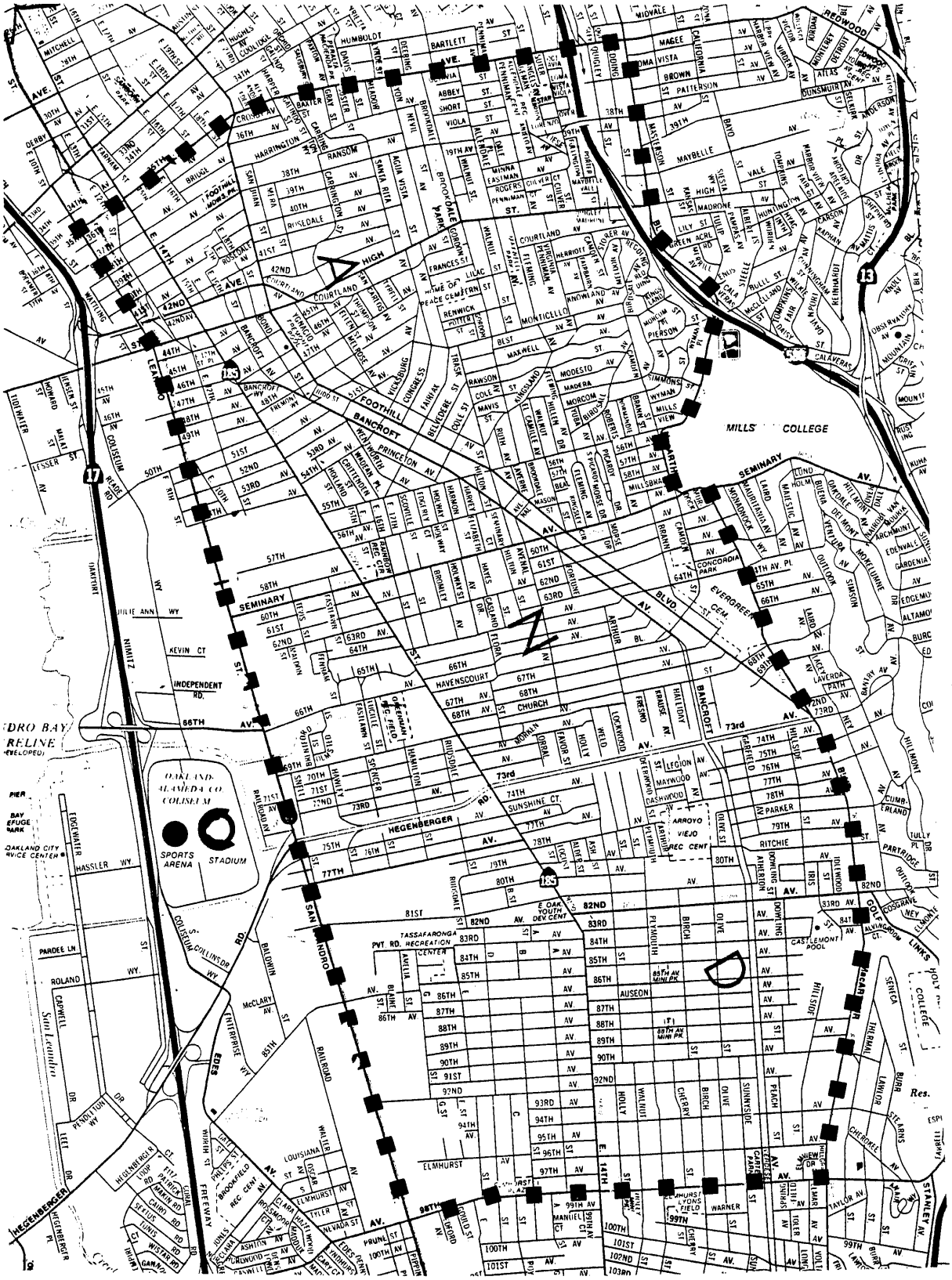
ROUTE 9


Los Altos
Los Altos Hills
Mountain View
Sunnyvale
Santa Clara
Cupertino
Campbell
Saratoga
Stevens Creek County Park
Great America Theme Pk.
Agnews State Hosp.
San Jose Municipal Airpo
Air Station Moffett Field
FREEWAY
CENTRAL EXPWY.
ALVISO FRWY.
CARIBBEAN DR.
MAUDE AV.
REED AV.
MONROE ST.
REMINGTON DR.
FREMONT AVE.
DUNHOLME WY.
DUNFORD WY.
HOMESTEAD ROAD
PRUNERIDGE AVE.
BENTON ST.
BELLOMY ST.
McCLELLAN RD.
BOLLINGER RD.
PROSPECT RD.
COX AVE.
ALLENDALE AV.
POLLARD RD.
WILLIAMS RD.
PAYNE AV.
HAMILTON
CAMPBELL AVE.
SARATOGA
SUNNYVALE
STEVENS CREEK
FOOTHILL BLVD.
SAN TOMAS AQUINO RD.
WINCHESTER
BASCOM
CAMDEN
Univ.

ROUTE 10



ROUTE 11A AND 11B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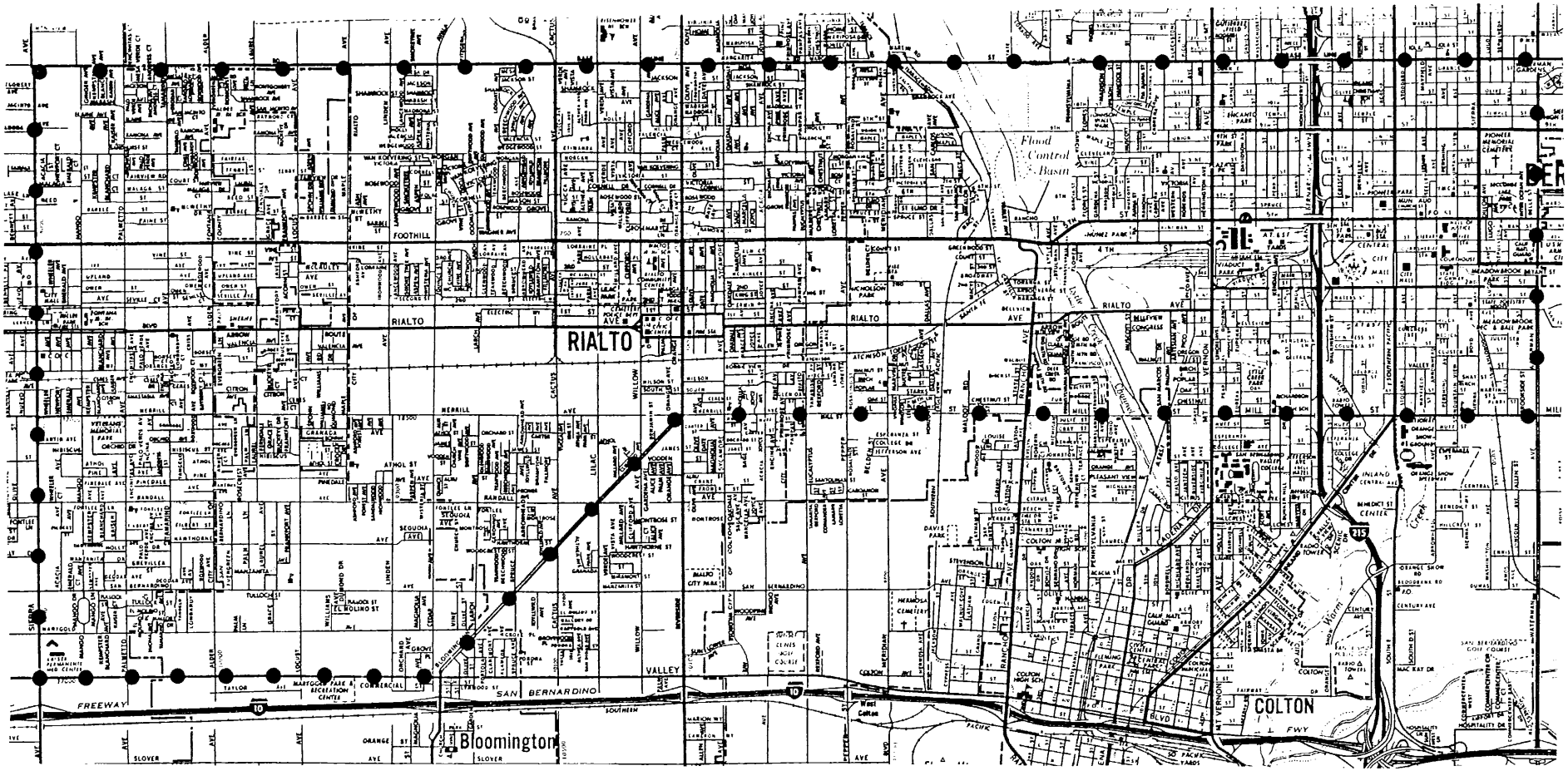
OAKLAND-ALAMEDA CO. COLISEUM
SPORTS ARENA
STADIUM
SAN LEANDRO
HEGENBERGER
FOOTHILL
BANCROFT
SEMINARY
NIMITZ FREEWAY
COLISEUM
INDEPENDENT RD.
ARROYO VIEJO REC CENT
CASTLEMONT POOL
TASSAFARONGA RECREATION CENTER
E OAK YOUTH DEV CENT
BROOKDALE PARK
CONCORDIA PARK
EVERGREEN CEM.
HOME OF PEACE CEMETERY
FOOTBALL MDWS PK.
OAKLAND CITY SERVICE CENTER
PIER
BAY BRIDGE PARK
San Leandro
Res.

ROUTE 12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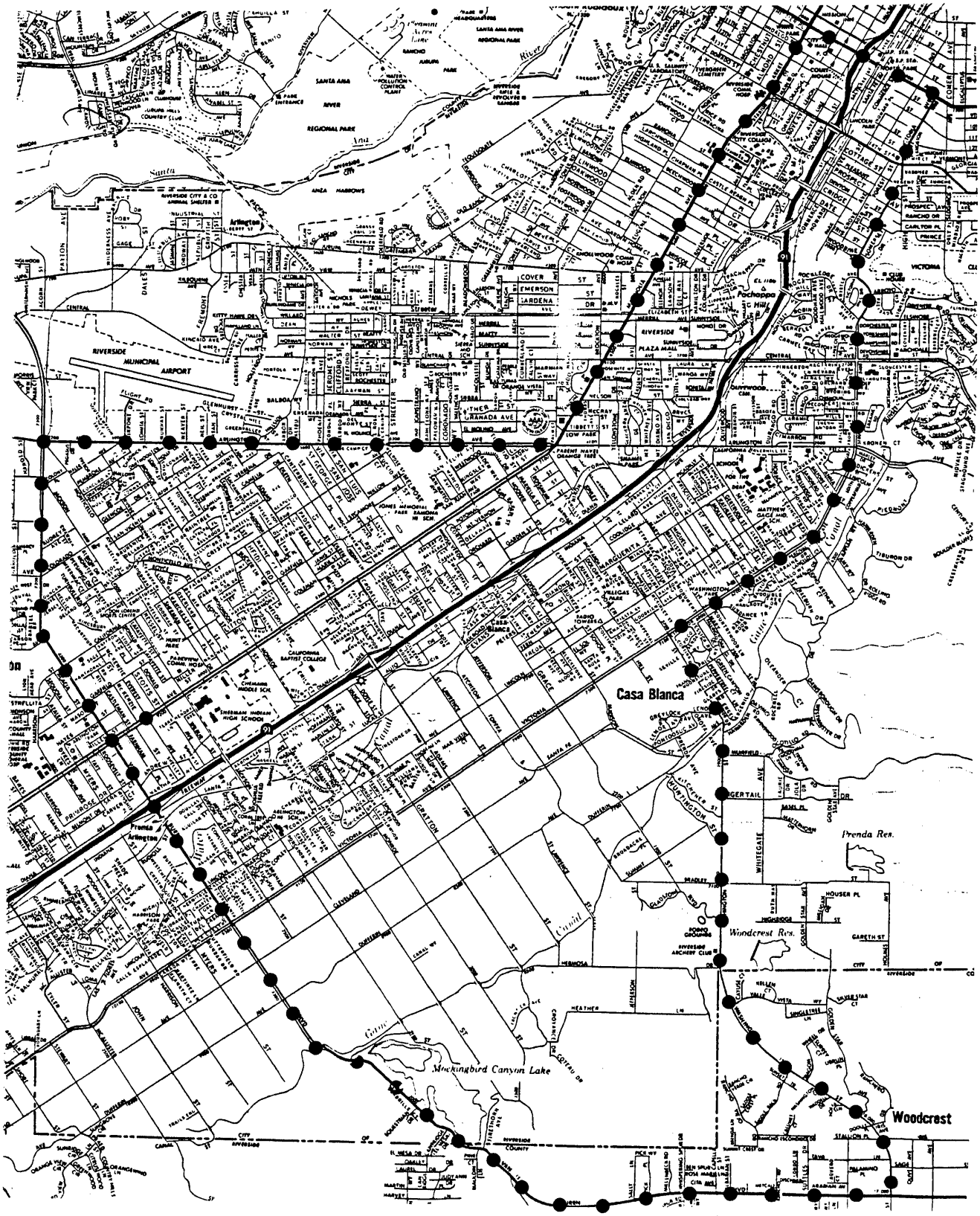
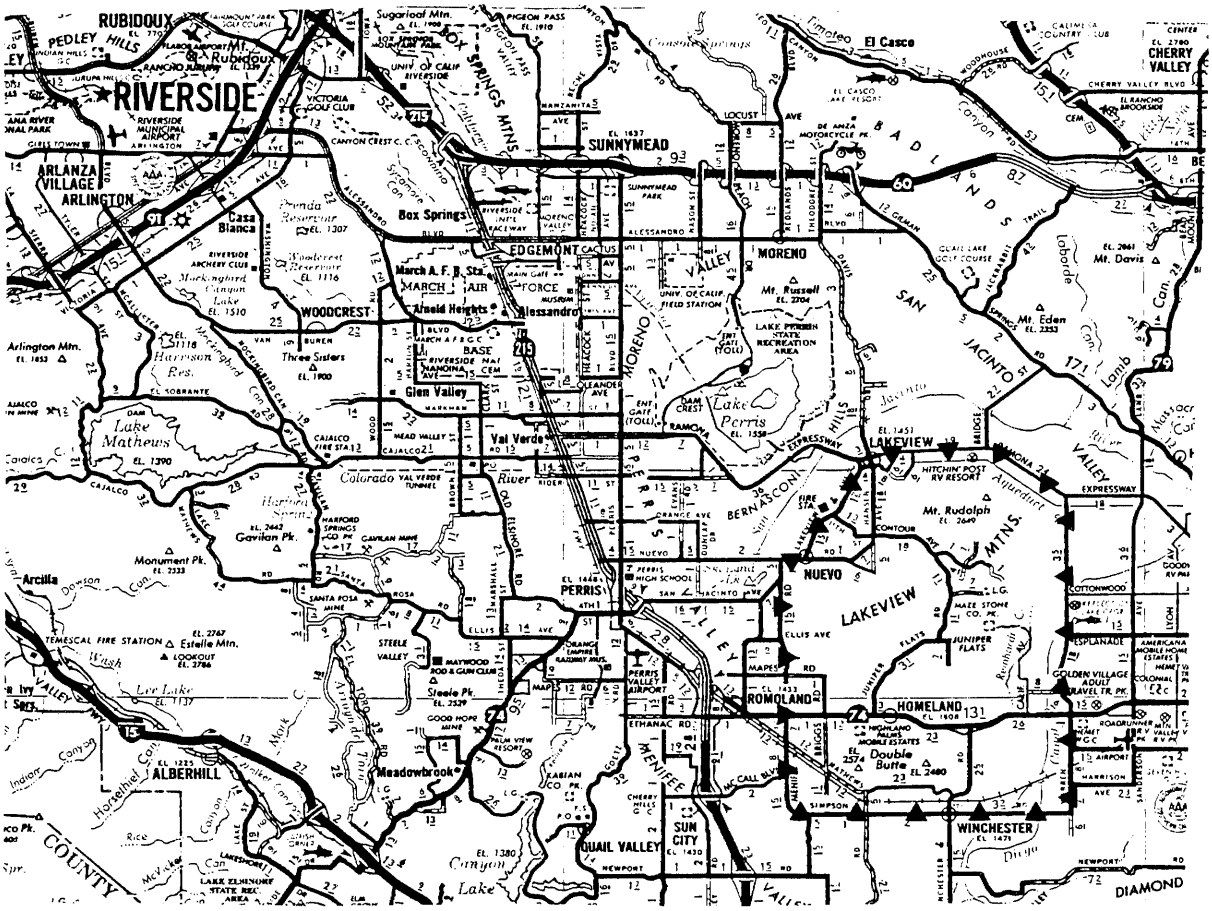
COLTON
Bloomington
Flood Control Basin
FOOTHILL
RIALTO
VALLEY
SAN BERNARDINO
FREEWAY
SLOVER
MILL
MT VERNON
BLVD
FWY
CENTER
Warm Creek

ROUTE 13


Casa Blanca
Prenda Res.
Woodcrest Res.
Mockingbird Canyon Lake
Woodcrest
RIVERSIDE MUNICIPAL AIRPORT
REGIONAL PARK
Arlington
Canal

ROUTE 14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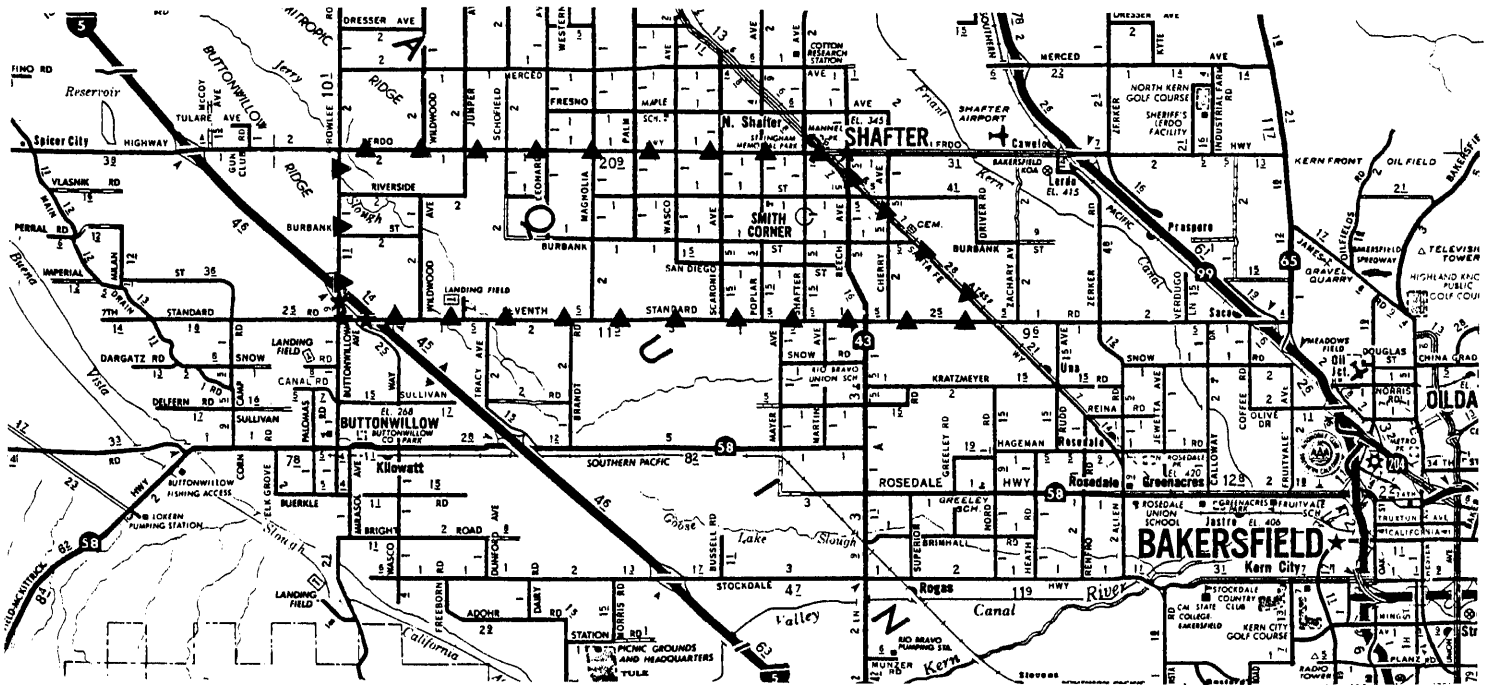
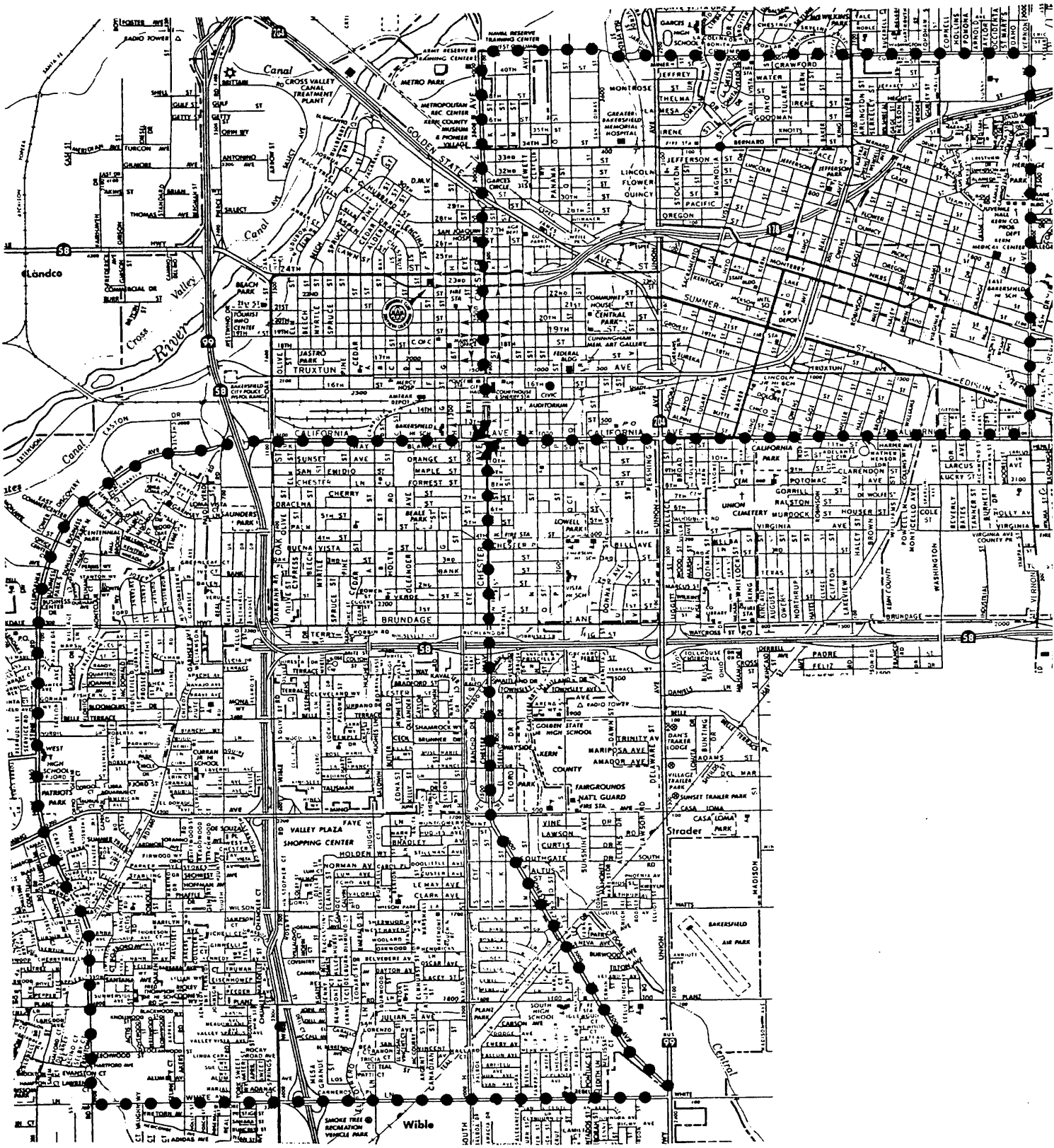
RIVERSIDE
ARLANZA VILLAGE
ARLINGTON
Casa Blanca
Box Springs
EDGEMONT
SUNNYMEAD
MORENO
WOODCREST
Alessandro
Glen Valley
Val Verde
Lake Mathews
Lake Perris
LAKEVIEW
NUEVO
PERRIS
ROMOLAND
HOMELAND
WINCHESTER
ALBERHILL
Meadowbrook
QUAIL VALLEY
SUN CITY
El Casco
CHERRY VALLEY
Mt. Russell
Mt. Eden
Mt. Davis
Mt. Rudolph
Double Butte
Arcilla
Monument Pk.
Gavilan Pk.
Steele Pk.
Lee Lake
Canyon Lake
Colorado River
SAN JACINTO
LAKEVIEW MTNS.
BADLANDS
MENIFEE
COUNTY
DIAMOND

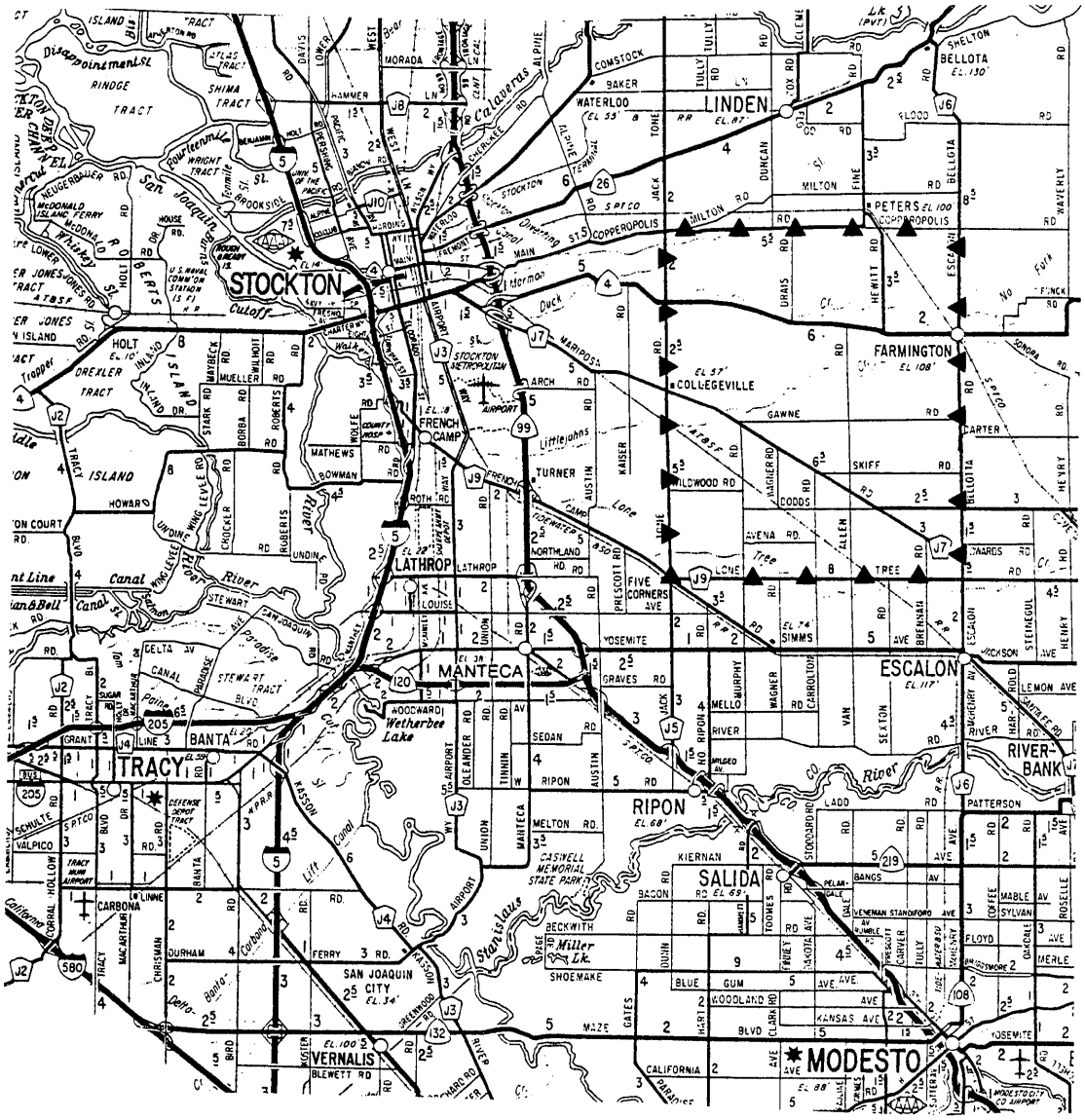
ROUTE 15


SHAFTER
N. Shafter
SMITH CORNER
BUTTONWILLOW
Kiowatt
BAKERSFIELD
Kern City
Rosedale
Greenacres
Lerdo
Prospero
Spicer City
Reservoir
SOUTHERN PACIFIC
Kern River
Canal
Valley
Lake
Slough
California
Buena Vista
Jerry
RIDGE
BUTTONWILLOW RIDGE
SHAFTER AIRPORT
COTTON RESEARCH STATION
NORTH KERN GOLF COURSE
SHERIFF'S LERDO FACILITY
KERN FRONT OIL FIELD
GRAVEL QUARRY
TELEVISION TOWER
HIGHLAND KNOLL PUBLIC GOLF COURSE
MEADOWS FIELD
OILDALE
KERN CITY GOLF COURSE
RADIO TOWER
PICNIC GROUNDS AND HEADQUARTERS
RIO BRAVO PUMPING STA.
LOKERN PUMPING STATION
BUTTONWILLOW FISHING ACCESS
LANDING FIELD
ROSEDALE UNION SCHOOL
RIO BRAVO UNION SCH
GREELEY SCH
COLLEGE
CM STATE CLUB
STOCKDALE COUNTRY CLUB
DRESSER AVE
MERCED
FRESNO
TULARE AVE
HIGHWAY
VLASNIK RD
PERRAL RD
IMPERIAL
STANDARD
DARGATZ RD
DELFERN RD
SNOW
SULLIVAN
CANAL RD
BURBANK
RIVERSIDE
SAN DIEGO
KRATZMEYER
HAGEMAN
ROSEDALE
BRIMHALL
STOCKDALE
BUERKLE
BRIGHT
ADOHR
FREEBORN
DUNFORD
WASCO
MAGNOLIA
SCHOFIELD
JUNIPER
WILDWOOD
ROWLEE
CORN
PALOMAS
TRACY AVE
BRANDT
MAYER
MARTIN
CHERRY
BEECH
POPLAR
SHAFTER
WESTERN
COLLEGE
MORRIS RD
BUSSELL RD
SUPERIOR
GREELEY
REINA
HEATH
ZERKER
DRIVER RD
ZACHARY AV
JEWETTA AVE
CALLOWAY
COFFEE RD
OLIVE DR
FRUITVALE
DOUGLAS ST
CHINA GRADE
NORRIS RD
JAMES
OILFIELDS
BAKERSFIELD
Kern City
Rosedale
Greenacres
Lerdo
Prospero
Una
Rogas
Spicer City
Reservoir
Kern River
Canal
Valley
Lake
Slough
California
Buena Vista
Jerry
RIDGE
BUTTONWILLOW RIDGE
SHAFTER AIRPORT
COTTON RESEARCH STATION
NORTH KERN GOLF COURSE
SHERIFF'S LERDO FACILITY
KERN FRONT OIL FIELD
GRAVEL QUARRY
TELEVISION TOWER
HIGHLAND KNOLL PUBLIC GOLF COURSE
MEADOWS FIELD
OILDALE
KERN CITY GOLF COURSE
RADIO TOWER
PICNIC GROUNDS AND HEADQUARTERS
RIO BRAVO PUMPING STA.
LOKERN PUMPING STATION
BUTTONWILLOW FISHING ACCESS
LANDING FIELD
ROSEDALE UNION SCHOOL
RIO BRAVO UNION SCH
GREELEY SCH
COLLEGE
CM STATE CLUB
STOCKDALE COUNTRY CLUB
DRESSER AVE
MERCED
FRESNO
TULARE AVE
HIGHWAY
VLASNIK RD
PERRAL RD
IMPERIAL
STANDARD
DARGATZ RD
DELFERN RD
SNOW
SULLIVAN
CANAL RD
BURBANK
RIVERSIDE
SAN DIEGO
KRATZMEYER
HAGEMAN
ROSEDALE
BRIMHALL
STOCKDALE
BUERKLE
BRIGHT
ADOHR
FREEBORN
DUNFORD
WASCO
MAGNOLIA
SCHOFIELD
JUNIPER
WILDWOOD
ROWLEE
CORN
PALOMAS
TRACY AVE
BRANDT
MAYER
MARTIN
CHERRY
BEECH
POPLAR
SHAFTER
WESTERN
COLLEGE
MORRIS RD
BUSSELL RD
SUPERIOR
GREELEY
REINA
HEATH
ZERKER
DRIVER RD
ZACHARY AV
JEWETTA AVE
CALLOWAY
COFFEE RD
OLIVE DR
FRUITVALE
DOUGLAS ST
CHINA GRADE
NORRIS RD
JAMES
OILFIELDS
BAKERSFIELD
Kern City
Rosedale
Greenacres
Lerdo
Prospero
Una
Rogas

ROUTE 16


Canal
CROSS VALLEY CANAL TREATMENT PLANT
METRO PARK
GOLDEN STATE
Landco
Cross Valley
River
TRUXTUN
CALIFORNIA
BRUNDAGE
SUMNER
CHESTER
VALLEY PLAZA SHOPPING CENTER
Strader
Wible
Central

ROUTE 17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FARMINGTON
COLLEGEVILLE
FRENCH CAMP
LATHROP
MANTECA
ESCALON
TRACY
BANTA
RIPON
SALIDA
MODESTO
VERNALIS
SAN JOAQUIN CITY
CARBONA
RIVER-BANK
BELLOTA
PETERS
COPPEROPOLIS
FIVE CORNERS
SIMMS
Wetherbee Lake
CASWELL MEMORIAL STATE PARK
Miller Lk.
San Joaquin River
Stanislaus River
Old River
Tom Paine Slough
Calaveras River
Littlejohns Creek
Duck Creek
Mormon Slough
Corral Hollow Creek
Delta-Mendota Canal
Main Canal
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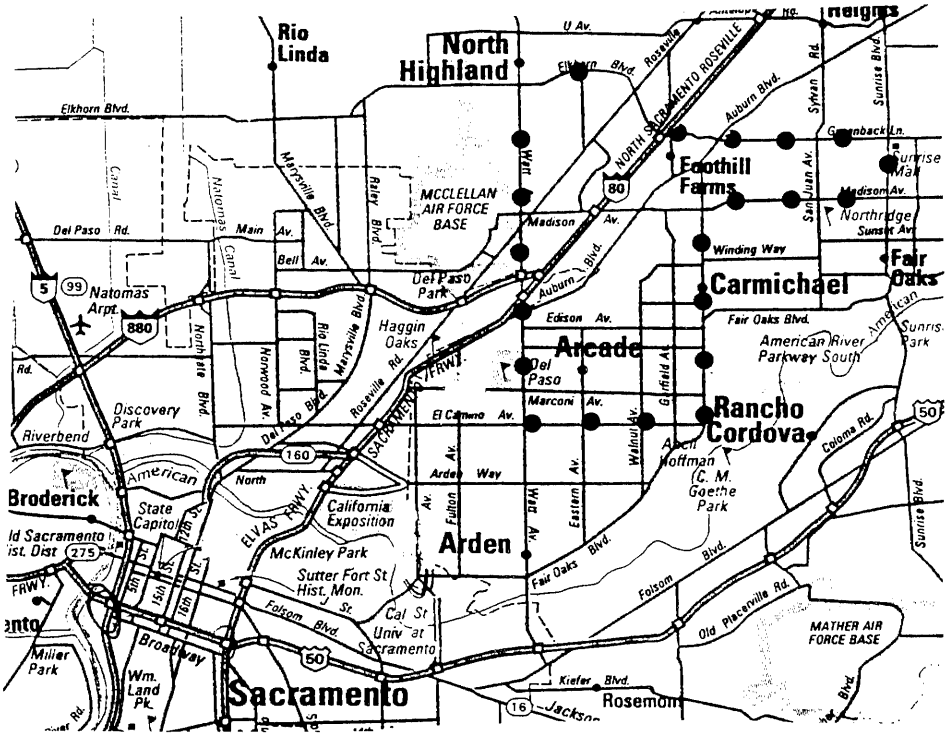
ROUTE 18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Sunrise Blvd.
Greenback Ln.
Foothill Farms
Sunrise Mall
Madison Av.
Northridge
Sunset Av.
Fair Oaks
Carmichael
Winding Way
Madison Av.
MCCLELLAN AIR FORCE BASE
Del Paso Rd.
Main Av.
Bell Av.
Natomas Canal
Marysville Blvd.
Raley Blvd.
Del Paso Park
Auburn Blvd.
Natomas Arpt.
Edison Av.
Fair Oaks Blvd.
American River Parkway South
Sunrise Park
Haggin Oaks
Arcade
Del Paso
Marconi Av.
El Camino Av.
Rancho Cordova
Discovery Park
Riverbend
Arden Way
Arden
Fulton Av.
Eastern Av.
Walnut Av.
Garfield Av.
Coloma Rd.
Broderick
State Capitol
California Exposition
McKinley Park
Sutter Fort St Hist. Mon.
Cal St Univ at Sacramento
Folsom Blvd.
Fair Oaks Blvd.
Old Placerville Rd.
MATHER AIR FORCE BASE
Miller Park
Wm. Land Pk.
Broadway
Sacramento
Kiefer Blvd.
Rosemont
Jackson
Sunrise Blvd.
American
North
ELVAS FRWY.
SACRAMENTO FRWY.
Roseville Rd.
Rio Linda Blvd.
Norwood Av.
Northgate Blvd.
Del Paso Blvd.
Sacramento Hist. Dist
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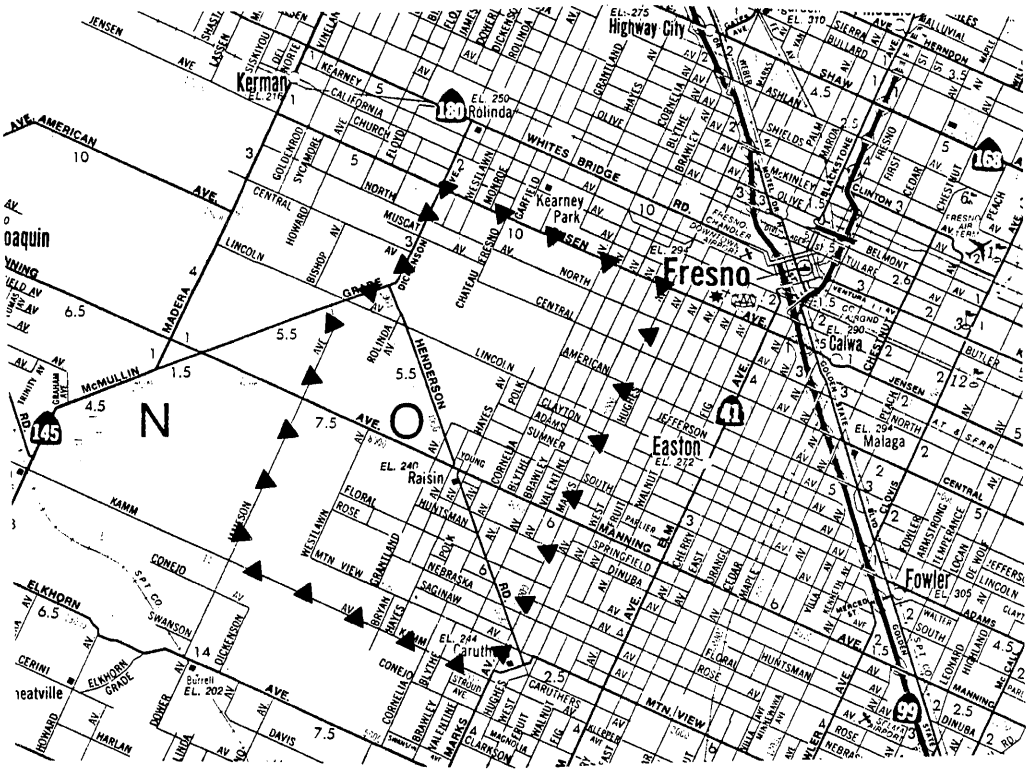
ROUTE 19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Sanger
Parlier
Orange Cove
Dinuba
Visalia
Tulare
Hanford
Lemoore
Coalinga
Avenal
Kingsburg
Sanger
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Dinuba
Selma
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GRADE
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CONEJO
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DAVIS
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ADAMS
SUMNER
JEFFERSON
SOUTH
MANNING
FLORAL
ROSE
HUNTSMAN
MTN VIEW
NEBRASKA
SAGINAW
GARFIELD
MOUNTAIN VIEW
SHAW
BULLARD
BELMONT
TULARE
OLIVE
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ACADEMY
GOLDENROD
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ORANGE
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HENDERSON
HAYES
CORNELIA
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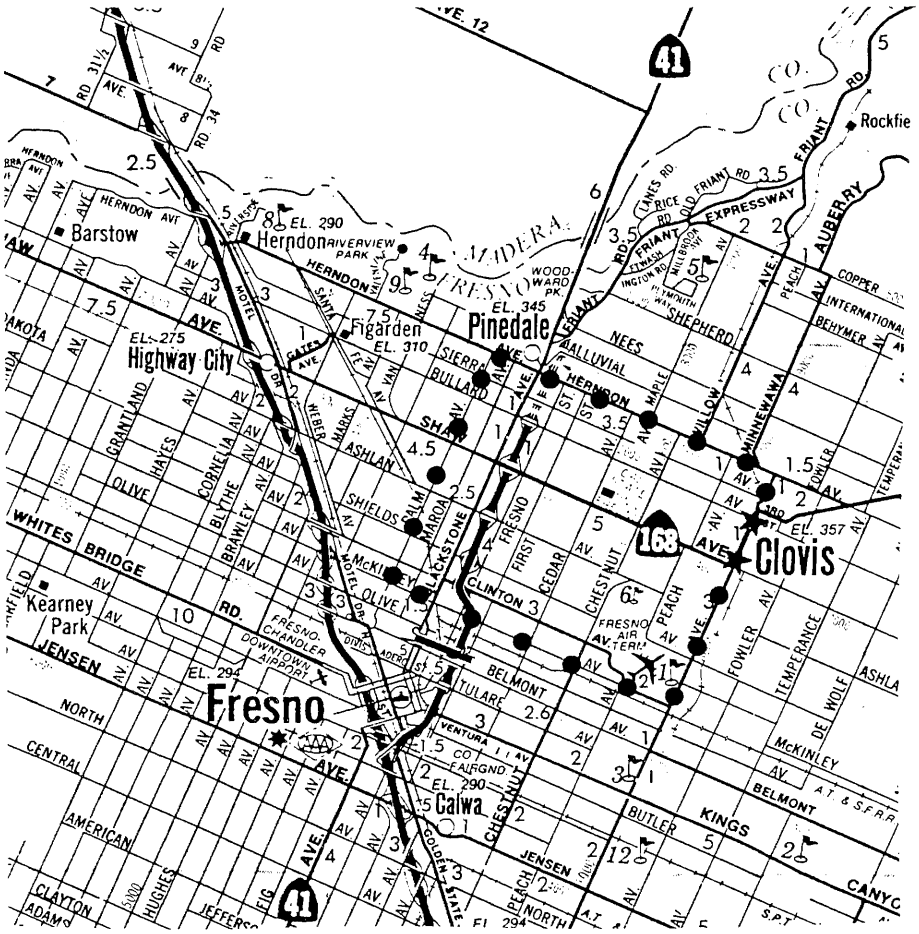
ROUTE 20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JENSEN
WHITES BRIDGE RD.
FRESNO AIR TERM
FRESNO-CHANDLER DOWNTOWN AIRPORT
EL. 290
EL. 345
EL. 310
EL. 275
EL. 357
EL. 294
MADERA
FRESNO
EXPRESSWAY
AUBERRY
MINNEWAWA
FRIANT
SHEPHERD
NEES
ALLUVIAL
BULLARD
SIERRA
ASHLAN
SHIELDS
MARIOA
BLACKSTONE
FIRST
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CHESTNUT
PEACH
FOWLER
TEMPERANCE
DE WOLF
McKINLEY
BUTLER
TULARE
VENTURA
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CLAYTON
HUGHES
NORTH
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HAYES
CORNELIA
BLYTHE
BRAWLEY
OLIVE
WEBER
MARKS
SANTA FE
HERNDON AVE
RIVERVIEW PARK
WOODWARD PK.
COPPER
INTERNATIONAL
BEHYMER
RICE
OLD FRIANT RD
CANYO

ROUTE 21

APPENDIX C

SUMMARY OF TRUCK COUNT DATA FROM THE PILOT AND FULL SURVEYS

This appendix contains the raw traffic count data from the pilot and full traffic surveys described in Appendix A. Tables C-1 through C-4 present data for the four pilot survey routes while Tables C-5 through C-27 present data for the remaining full survey routes. Individual route specifications (e.g., mileage, locale, etc.) can be found in Tables A-6 and B-1 of Appendices A and B. Numbers contained in the following tables represent the sums of the clockwise and counterclockwise team counts. The trip clock times shown for each trip represent the earliest starting time and the latest ending time for a given team over a given trip.

Table C-1. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 1, CARSON (URBAN-COUNTY PRINCIPAL ARTERIAL) - PILOT SURVEY

Axle Class	Trip Clock Time										Row Totals
	0630-0732	0847-0934	0940-1024	1055-1145	1148-1551	1400-1454	1458-1551	1600-1657	1731-1825	1946-2034	
2D	37	71	72	89	83	91	64	49	29	3	588
2T	1	1	3	2	2	4	7	5	1	0	26
2B	19	4	7	6	7	14	19	6	12	3	97
subtotal	57	76	82	97	92	109	90	60	42	6	711
3H	8	29	26	24	23	34	31	22	6	2	205
3T	6	16	6	16	6	16	7	8	8	2	91
3B	4	1	0	0	0	1	0	0	0	0	6
subtotal	18	46	32	40	29	51	38	30	14	4	302
4H	9	10	11	19	14	14	14	18	4	1	114
5H	37	70	82	89	81	109	78	59	19	10	634
6,7,8	0	0	1	1	0	1	1	1	0	0	5
subtotal	46	80	94	109	95	124	93	78	23	11	753
TOTAL	121	202	208	246	216	284	221	168	79	21	1,766

Table C-2. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 2, GARDEN GROVE (URBAN-COUNTY PRINCIPAL ARTERIAL) - PILOT SURVEY

Axle Class	Trip Clock Time										Row Totals
	0633-0732	0820-0917	0939-1033	1052-1154	1213-1314	1403-1505	1504-1606	1605-1707	1742-1848	1951-2048	
2DH	11	45	40	43	37	36	41	25	15	1	294
2DV	7	8	12	14	7	17	7	11	8	1	92
2DP	13	22	20	15	20	18	23	26	17	3	177
2DR	5	4	15	8	5	4	10	5	11	4	71
2DU	5	6	9	13	13	4	4	1	1	0	56
2T	0	3	0	1	0	0	1	3	0	1	9
2B	16	22	19	19	19	23	18	20	19	3	178
subtotal	57	110	115	113	101	102	104	91	71	13	877
3H	9	12	14	14	22	14	15	12	1	0	113
3T	0	1	1	0	0	1	1	1	2	1	8
3B	1	1	0	2	0	2	2	2	1	0	11
subtotal	10	14	15	16	22	17	18	15	4	1	132
4H	0	6	5	5	2	4	7	3	0	0	32
5H	8	5	10	13	16	9	8	7	4	4	84
6,7,8	1	0	0	0	0	0	0	0	0	0	1
subtotal	9	11	15	18	18	13	15	10	4	4	117
TOTAL	76	135	145	147	141	132	137	116	79	18	1,126

Table C-3. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 3, SAN FERNANDO VALLEY (URBAN-COUNTY PRINCIPAL ARTERIAL) - PILOT SURVEY

Axle Class	Trip Clock Time										Row Totals
	0619-0702	0826-0911	0942-1028	1058-1143	1222-1309	1345-1431	1444-1531	1545-1635	1714-1808	1815-1904	
2DH	9	56	49	49	42	50	31	38	14	10	348
2DV	6	16	18	6	12	26	18	16	18	4	140
2DP	16	39	32	32	19	20	18	20	16	13	225
2DR	1	4	3	4	2	0	5	1	4	2	26
2DU	6	6	12	7	9	4	1	7	2	2	56
2T	0	0	1	3	1	1	0	0	1	0	7
2B	20	34	17	13	22	28	36	34	19	22	245
subtotal	58	155	132	114	107	129	109	116	74	53	1,047
3H	15	35	33	34	19	25	18	13	2	6	200
3T	1	3	3	1	0	0	1	0	1	0	10
3B	0	0	0	2	0	0	1	1	0	0	4
subtotal	16	38	36	37	19	25	20	14	3	6	214
4H	7	4	2	12	2	4	8	6	9	5	59
5H	12	13	14	16	15	13	7	0	4	4	98
6,7,8	0	0	0	0	0	1	0	0	0	0	1
subtotal	19	17	16	28	17	18	15	6	13	9	158
TOTAL	93	210	184	179	143	172	144	136	90	68	1,419

Table C-4. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 4, PICO RIVERA (URBAN-COUNTY PRINCIPAL ARTERIAL) - PILOT SURVEY

Axle Class	Trip Clock Time										Row Totals
	0620-0710	0829-0920	0944-1033	1059-1152	1227-1321	1417-1515	1518-1620	1630-1732	1845-1936	1945-2035	
2DH	22	49	59	80	65	55	48	23	3	2	406
2DV	5	10	14	20	12	32	16	12	2	1	124
2DP	13	25	33	28	16	34	43	11	4	0	207
2DR	0	1	3	3	2	3	7	4	0	2	25
2DU	4	18	10	16	9	1	4	0	0	0	62
2T	1	2	3	3	3	2	3	6	2	1	26
2B	25	11	8	14	14	24	31	18	8	5	158
subtotal	70	116	130	164	121	151	152	74	19	11	1,008
3H	14	46	29	39	28	31	37	20	2	1	247
3T	4	4	3	5	4	9	8	7	3	0	47
3B	0	0	0	1	0	0	0	0	0	0	1
subtotal	18	50	32	45	32	40	45	27	5	1	295
4H	10	18	15	19	6	17	15	14	2	3	119
5H	29	43	59	54	51	61	57	32	16	3	405
6,7,8	0	2	1	0	0	0	1	0	0	0	4
subtotal	39	63	75	73	57	78	73	46	18	6	528
TOTAL	127	229	237	282	210	269	270	147	42	18	1,831

Table C-5. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 1X, CARSON (URBAN-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1030-1118	1120-1207	1324-1413	1433-1522	1545-1641	
2H	42	50	49	65	25	231
2B	8	4	6	12	8	38
2T	5	5	0	0	2	12
subtotal	55	59	55	77	35	281
2V	13	9	4	6	3	35
2PF	16	20	20	21	9	86
2PC	0	0	0	2	0	2
2PB	2	2	0	2	0	6
2W	1	2	3	2	3	11
2MH	0	0	1	1	0	2
2MB	0	0	1	1	0	2
2CV	6	5	3	6	4	24
subtotal	38	38	32	41	19	168
3H	29	32	30	30	17	138
3B	2	0	1	0	0	3
3T	9	5	11	12	9	46
subtotal	40	37	42	42	26	187
4H	9	8	10	13	13	53
5H	66	65	76	75	46	328
6,7,8	1	1	0	0	0	2
subtotal	76	74	86	88	59	383
TOTAL	209	208	215	248	139	1,019

Table C-6. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 2X, GARDEN GROVE (URBAN-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1016-1108	1116-1211	1318-1409	1431-1529	1545-1644	
2H	40	40	43	50	32	205
2B	16	15	17	19	24	91
2T	0	2	0	2	2	6
subtotal	56	57	60	71	58	302
2V	6	7	3	6	5	27
2PF	14	15	14	19	18	80
2PC	0	0	0	0	0	0
2PB	1	2	3	2	1	9
2W	2	2	4	2	1	11
2MH	2	2	2	6	3	15
2MB	2	3	2	4	0	11
2CV	8	8	11	11	16	54
subtotal	35	39	39	50	44	207
3H	6	10	14	11	4	45
3B	4	0	2	3	4	13
3T	1	1	1	2	2	7
subtotal	11	11	17	16	10	65
4H	6	1	4	5	1	17
5H	12	13	7	19	8	59
6,7,8	0	1	0	0	0	1
subtotal	18	15	11	24	9	77
TOTAL	120	122	127	161	121	651

Table C-7. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 3, SAN FERNANDO VALLEY (URBAN-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	0959-1042	1115-1201	1319-1409	1433-1528	1545-1638	
2H	50	79	54	43	39	265
2B	19	16	19	59	29	142
2T	0	1	1	0	1	3
subtotal	69	96	74	102	69	410
2V	6	14	11	14	6	51
2PF	13	19	13	20	31	96
2PC	1	0	1	1	1	4
2PB	2	5	4	2	1	14
2W	4	2	3	3	1	13
2MH	3	0	4	2	1	10
2MB	1	2	6	8	5	22
2CV	2	14	5	10	5	36
subtotal	32	56	47	60	51	246
3H	25	21	22	16	13	97
3B	0	0	0	0	0	0
3T	0	1	0	0	0	1
subtotal	25	22	22	16	13	98
4H	7	7	2	4	4	24
5H	11	19	16	14	11	71
6,7,8	1	0	1	0	1	3
subtotal	19	26	19	18	16	98
TOTAL	145	200	162	196	149	852

Table C-8. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 5, NORTHRIDGE (URBAN-COUNTY MINOR ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1000-1042	1115-1155	1318-1356	1418-1458	1530-1609	
2H	13	18	16	16	15	78
2B	3	3	6	9	5	26
2T	0	0	1	0	0	1
subtotal	16	21	23	25	20	105
2V	1	3	3	6	9	22
2PF	6	6	7	16	9	44
2PC	0	2	0	0	0	2
2PB	0	1	1	3	2	7
2W	2	0	0	0	1	3
2MH	0	1	0	1	1	3
2MB	0	0	5	2	1	8
2CV	7	1	1	2	2	13
subtotal	16	14	17	30	25	102
3H	8	7	9	8	12	44
3B	0	0	0	1	0	1
3T	0	0	0	0	0	0
subtotal	8	7	9	9	12	45
4H	1	3	1	2	1	8
5H	2	2	1	2	2	9
6,7,8	0	0	0	0	0	0
subtotal	3	5	2	4	3	17
TOTAL	43	47	51	68	60	269

Table C-9. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 6, GARDEN GROVE (URBAN-COUNTY MINOR ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1023-1109	1120-1208	1318-1405	1432-1523	1544-1638	
2H	13	11	16	21	8	69
2B	0	2	3	7	3	15
2T	0	1	0	0	0	1
subtotal	13	14	19	28	11	85
2V	5	5	5	8	1	24
2PF	7	10	6	9	6	38
2PC	0	0	0	0	0	0
2PB	2	1	0	0	1	4
2W	2	2	0	3	2	9
2MH	1	1	0	3	1	6
2MB	2	1	1	5	1	10
2CV	0	2	1	1	2	6
subtotal	19	22	13	29	14	97
3H	6	2	4	4	2	18
3B	1	0	1	2	1	5
3T	0	0	0	0	1	1
subtotal	7	2	5	6	4	24
4H	0	0	0	6	1	7
5H	2	4	4	1	2	13
6,7,8	0	0	0	0	0	0
subtotal	2	4	4	7	3	20
TOTAL	41	42	41	70	32	226

Table C-10. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 7A, SAN DIEGO/MIRAMAR (URBAN-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1025-1103	1118-1201	1323-1404	1430-1519	1545-1631	
2H	33	34	53	31	23	174
2B	2	6	8	3	12	31
2T	1	0	3	0	2	6
subtotal	36	40	64	34	37	211
2V	5	2	2	3	3	15
2PF	10	12	12	21	16	71
2PC	0	0	0	0	0	0
2PB	0	1	3	1	1	6
2W	1	3	1	2	1	8
2MH	0	0	0	0	0	0
2MB	0	1	5	2	2	10
2CV	3	11	6	4	8	32
subtotal	19	30	29	33	31	142
3H	28	25	23	30	14	120
3B	0	0	0	0	0	0
3T	2	0	3	0	2	7
subtotal	30	25	26	30	16	127
4H	2	7	4	4	4	21
5H	29	25	24	14	9	101
6,7,8	0	0	0	0	0	0
subtotal	31	32	28	18	13	122
TOTAL	116	127	147	115	97	602

Table C-11. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 7B, SAN DIEGO/MIRAMAR (URBAN-COUNTY MINOR ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1025-1103	1118-1201	1323-1404	1430-1519	1545-1631	
2H	6	12	10	9	4	41
2B	2	1	0	2	5	10
2T	0	0	0	0	0	0
subtotal	8	13	10	11	9	51
2V	1	1	1	0	4	7
2PF	5	5	5	3	8	26
2PC	0	1	0	0	1	2
2PB	0	0	1	0	0	1
2W	1	1	0	0	0	2
2MH	2	1	1	0	1	5
2MB	1	0	0	2	0	3
2CV	4	6	3	2	1	16
subtotal	14	15	11	7	15	62
3H	12	8	6	7	7	40
3B	0	0	0	0	0	0
3T	0	1	0	0	1	2
subtotal	12	9	6	7	8	42
4H	1	0	1	1	0	3
5H	6	4	4	3	3	20
6,7,8	0	0	0	0	0	0
subtotal	7	4	5	4	3	23
TOTAL	41	41	32	29	35	178

Table C-12. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 8A, SAN DIEGO/DOWNTOWN (URBAN-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1007-1053	1116-1208	1340-1435	1446-1533	1545-1638	
2H	15	15	5	6	4	45
2B	2	8	7	8	11	36
2T	0	0	0	0	0	0
subtotal	17	23	12	14	15	81
2V	1	2	1	4	2	10
2PF	1	5	1	3	2	12
2PC	0	0	1	1	1	3
2PB	1	2	1	1	0	5
2W	1	0	0	0	1	2
2MH	2	0	0	4	4	10
2MB	0	1	1	6	1	9
2CV	4	5	3	2	3	17
subtotal	10	15	8	21	14	68
3H	5	7	10	2	3	27
3B	0	1	2	1	2	6
3T	0	0	0	0	1	1
subtotal	5	8	12	3	6	34
4H	0	1	0	0	0	1
5H	5	1	7	2	3	18
6,7,8	0	0	0	0	0	0
subtotal	5	2	7	2	3	19
TOTAL	37	48	39	40	38	202

Table C-13. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 8B, SAN DIEGO/DOWNTOWN (URBAN-COUNTY MINOR ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1007-1053	1116-1208	1340-1435	1446-1533	1545-1638	
2H	4	4	5	3	10	26
2B	19	18	17	11	25	90
2T	0	1	0	0	0	1
subtotal	23	23	22	14	35	117
2V	4	1	2	2	1	10
2PF	1	2	1	2	3	9
2PC	0	0	0	0	0	0
2PB	0	2	1	0	1	4
2W	0	0	1	0	0	1
2MH	1	0	0	0	0	1
2MB	0	0	2	0	1	3
2CV	1	3	2	1	5	12
subtotal	7	8	9	5	11	40
3H	2	2	1	0	1	6
3B	4	6	4	7	9	30
3T	0	1	0	0	0	1
subtotal	6	9	5	7	10	37
4H	0	2	0	0	0	2
5H	2	0	0	0	0	2
6,7,8	0	0	0	0	0	0
subtotal	2	2	0	0	0	4
TOTAL	38	42	36	26	56	198

Table C-14. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 9, REDWOOD CITY (URBAN-COUNTY MINOR ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	0930-1026	1045-1134	1300-1349	1415-1507	1545-1644	
2H	13	14	23	14	15	79
2B	6	8	5	11	11	41
2T	1	0	0	1	0	2
subtotal	20	22	28	26	26	122
2V	2	5	1	5	2	15
2PF	5	3	6	5	6	25
2PC	0	0	0	0	0	0
2PB	2	0	2	2	0	6
2W	2	1	2	0	1	6
2MH	0	0	0	0	0	0
2MB	2	0	1	2	2	7
2CV	0	5	0	2	1	8
subtotal	13	14	12	16	12	67
3H	5	4	7	16	4	36
3B	0	0	0	0	0	0
3T	0	1	1	0	0	2
subtotal	5	5	8	16	4	38
4H	2	0	0	3	0	5
5H	7	7	3	5	1	23
6,7,8	0	0	0	0	2	2
subtotal	9	7	3	8	3	30
TOTAL	47	48	51	66	45	257

Table C-15. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 10, SUNNYVALE (URBAN-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	0940-1035	1044-1130	1305-1353	1417-1514	1549-1644	
2H	36	37	40	34	27	174
2B	9	7	13	10	15	54
2T	0	0	0	0	0	0
subtotal	45	44	53	44	42	228
2V	1	2	6	7	4	20
2PF	11	11	3	9	15	49
2PC	0	1	0	0	1	2
2PB	0	6	1	3	0	10
2W	2	1	4	4	3	14
2MH	0	1	1	1	0	3
2MB	0	0	0	0	0	0
2CV	3	6	4	6	12	31
subtotal	17	28	19	30	35	129
3H	6	12	11	14	13	56
3B	0	0	0	0	0	0
3T	0	2	0	3	0	5
subtotal	6	14	11	17	13	61
4H	4	2	3	0	3	12
5H	12	10	9	21	1	53
6,7,8	0	0	0	0	0	0
subtotal	16	12	12	21	4	65
TOTAL	84	98	95	112	94	483

Table C-16. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 11A, SAN FRANCISCO (URBAN-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	0930-1028	1045-1135	1300-1350	1415-1513	1544-1649	
2H	34	38	27	47	33	179
2B	29	31	33	42	45	180
2T	2	2	0	1	2	7
subtotal	65	71	60	90	80	366
2V	8	9	6	6	6	35
2PF	8	15	10	6	4	43
2PC	0	0	0	0	0	0
2PB	2	1	1	3	4	11
2W	8	3	3	6	1	21
2MH	0	1	0	0	1	2
2MB	1	1	4	5	1	12
2CV	3	5	1	3	5	17
subtotal	30	35	25	29	22	141
3H	15	11	15	14	10	65
3B	0	0	0	0	0	0
3T	1	1	0	0	1	3
subtotal	16	12	15	14	11	68
4H	3	3	2	2	3	13
5H	18	14	10	12	6	60
6,7,8	0	0	0	0	0	0
subtotal	21	17	12	14	9	73
TOTAL	132	135	112	147	122	648

Table C-17. NUMBER OF HDV' BY AXLE CLASS -- ROUTE 11B, SAN FRANCISCO (URBAN MINOR ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	0930-1028	1045-1135	1300-1350	1415-1513	1544-1649	
2H	2	2	2	2	0	8
2B	5	2	10	4	2	23
2T	0	0	0	0	0	0
subtotal	7	4	12	6	2	31
2V	3	2	0	1	0	6
2PF	0	1	0	0	1	2
2PC	0	0	0	0	0	0
2PB	0	0	0	0	0	0
2W	0	2	0	0	0	2
2MH	0	0	0	0	0	0
2MB	0	0	0	1	0	1
2CV	1	0	0	0	0	1
subtotal	4	5	0	2	1	12
3H	1	0	1	0	0	2
3B	0	0	0	0	0	0
3T	0	0	0	0	0	0
subtotal	1	0	1	0	0	2
4H	0	0	0	0	0	0
5H	0	0	0	0	0	0
6,7,8	0	0	0	0	0	0
subtotal	0	0	0	0	0	0
TOTAL	12	9	13	8	3	45

Table C-18. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 12, OAKLAND (URBAN MINOR ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1011-1120	1127-1224	1330-1426	1431-1529	1543-1642	
2H	25	24	27	31	22	129
2B	19	19	22	40	34	134
2T	1	0	0	0	0	1
subtotal	45	43	49	71	56	264
2V	3	7	3	7	4	24
2PF	4	6	4	7	9	30
2PC	0	0	0	0	1	1
2PB	0	0	2	1	1	4
2W	9	10	8	6	4	37
2MH	1	2	0	1	1	5
2MB	0	0	2	0	0	2
2CV	4	1	2	3	3	13
subtotal	21	26	21	25	23	116
3H	6	8	13	12	8	47
3B	0	0	0	2	2	4
3T	1	1	2	2	2	8
subtotal	7	9	15	16	12	59
4H	1	5	3	2	1	12
5H	14	31	17	14	8	84
6,7,8	1	0	0	0	0	1
subtotal	16	36	20	16	9	97
TOTAL	89	114	105	128	100	536

Table C-19. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 13, SAN BERNARDINO (MIXED-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1006-1057	1106-1159	1323-1419	1431-1528	1546-1641	
2H	23	17	28	20	10	98
2B	0	5	15	16	2	38
2T	0	2	2	1	1	6
subtotal	23	24	45	37	13	142
2V	7	2	3	3	2	17
2PF	7	10	9	14	19	59
2PC	1	0	0	0	1	2
2PB	2	1	1	1	3	8
2W	2	2	1	5	2	12
2MH	2	0	2	2	3	9
2MB	0	2	2	3	1	8
2CV	3	3	7	1	2	16
subtotal	24	20	25	29	33	131
3H	9	4	8	6	4	31
3B	1	0	0	0	1	2
3T	3	0	2	2	0	7
subtotal	13	4	10	8	5	40
4H	5	3	4	0	1	13
5H	13	6	5	11	3	38
6,7,8	0	0	1	1	0	2
subtotal	18	9	10	12	4	53
TOTAL	78	57	90	86	55	366

Table C-20. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 14, RIVERSIDE (MIXED-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1001-1047	1059-1147	1315-1405	1430-1522	1542-1631	
2H	16	19	27	22	14	98
2B	7	6	9	14	6	42
2T	0	1	1	2	1	5
subtotal	23	26	37	38	21	145
2V	3	2	2	3	1	11
2PF	12	5	14	10	13	54
2PC	1	0	0	0	0	1
2PB	4	2	0	0	0	6
2W	0	2	3	2	1	8
2MH	1	2	4	4	1	12
2MB	0	0	3	1	2	6
2CV	2	2	3	3	2	12
subtotal	23	15	29	23	20	110
3H	5	11	8	3	2	29
3B	1	0	0	1	1	3
3T	0	1	1	0	1	3
subtotal	6	12	9	4	4	35
4H	4	3	1	2	2	12
5H	6	10	11	10	4	41
6,7,8	0	0	0	0	0	0
subtotal	10	13	12	12	6	53
TOTAL	62	66	87	77	51	343

Table C-21. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 15, RIVERSIDE COUNTY (MIXED-COUNTY MAJOR COLLECTOR)

Axle Class	Trip Clock Time					Row Totals
	0951-1033	1100-1140	1301-1347	1405-1443	1459-1538	
2H	7	3	7	10	6	33
2B	0	0	0	2	0	2
2T	0	0	1	0	0	1
subtotal	7	3	8	12	6	36
2V	3	0	1	0	0	4
2PF	5	1	2	9	3	20
2PC	1	0	0	0	0	1
2PB	0	0	0	1	0	1
2W	0	0	0	0	0	0
2MH	1	0	0	0	1	2
2MB	0	0	0	0	0	0
2CV	1	1	0	2	4	8
subtotal	11	2	3	12	8	36
3H	3	1	1	1	0	6
3B	0	0	1	1	0	2
3T	0	0	0	0	0	0
subtotal	3	1	2	2	0	8
4H	2	1	1	2	1	7
5H	5	4	5	0	7	21
6,7,8	1	0	0	0	0	1
subtotal	8	5	6	2	8	29
TOTAL	29	11	19	28	22	109

Table C-22. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 16, KERN COUNTY (MIXED-COUNTY MAJOR COLLECTOR)

Axle Class	Trip Clock Time					Row Totals
	1000-1041	1100-1139	1316-1353	1433-1513	1546-1624	
2H	2	5	2	6	2	17
2B	0	0	1	1	0	2
2T	2	0	0	1	0	3
subtotal	4	5	3	8	2	22
2V	0	0	0	0	0	0
2PF	3	2	6	5	22	38
2PC	1	0	0	0	0	1
2PB	0	0	0	0	1	1
2W	0	0	0	0	0	0
2MH	0	0	0	1	0	1
2MB	0	0	0	0	1	1
2CV	0	0	0	0	0	0
subtotal	4	2	6	6	24	42
3H	7	3	1	6	1	18
3B	0	0	0	0	2	2
3T	5	0	0	0	0	5
subtotal	12	3	1	6	3	25
4H	1	0	0	2	1	4
5H	8	9	13	12	11	53
6,7,8	0	0	0	0	0	0
subtotal	9	9	13	14	12	57
TOTAL	29	19	23	34	41	146

Table C-23. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 17, BAKERSFIELD (MIXED-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1012-1102	1110-1159	1322-1411	1435-1527	1548-1638	
2H	20	20	32	28	16	116
2B	15	15	16	13	9	68
2T	0	0	0	1	0	1
subtotal	35	35	48	42	25	185
2V	0	2	3	4	5	14
2PF	12	20	16	31	24	103
2PC	0	0	1	0	0	1
2PB	0	0	0	0	2	2
2W	3	2	0	3	0	8
2MH	1	0	1	1	0	3
2MB	2	1	7	8	0	18
2CV	0	6	10	3	4	23
subtotal	18	31	38	50	35	172
3H	10	14	12	7	6	49
3B	0	0	0	0	1	1
3T	0	1	0	0	1	2
subtotal	10	15	12	7	8	52
4H	1	1	1	0	1	4
5H	2	6	4	6	0	18
6,7,8	0	0	0	0	0	0
subtotal	3	7	5	6	1	22
TOTAL	66	88	103	105	69	431

Table C-24. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 18, STOCKTON (MIXED-COUNTY MAJOR COLLECTOR)

Axle Class	Trip Clock Time					Row Totals
	1015-1100	1115-1202	1321-1404	1447-1532	1546-1629	
2H	4	5	8	6	3	26
2B	0	0	1	3	2	6
2T	0	0	0	0	0	0
subtotal	4	5	9	9	5	32
2V	0	0	0	0	0	0
2PF	3	3	0	4	4	14
2PC	0	0	0	0	0	0
2PB	0	0	0	0	0	0
2W	0	0	0	0	0	0
2MH	2	0	0	0	0	2
2MB	0	0	0	1	0	1
2CV	0	0	0	2	0	2
subtotal	5	3	0	7	4	19
3H	4	1	3	0	0	8
3B	0	0	0	0	0	0
3T	0	1	0	0	0	1
subtotal	4	2	3	0	0	9
4H	2	0	1	2	0	5
5H	7	5	8	11	4	35
6,7,8	0	0	0	1	0	1
subtotal	9	5	9	14	4	41
TOTAL	22	15	21	30	13	101

Table C-25. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 19, SACRAMENTO (MIXED-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1000-1047	1100-1150	1319-1408	1433-1524	1545-1643	
2H	30	31	35	31	18	145
2B	12	16	15	23	14	80
2T	1	2	0	0	0	3
subtotal	43	49	50	54	32	228
2V	8	7	8	4	4	31
2PF	9	15	26	8	17	75
2PC	0	0	0	0	0	0
2PB	1	3	2	0	5	11
2W	2	4	0	4	4	14
2MH	3	7	2	3	1	16
2MB	1	1	2	2	1	7
2CV	2	9	8	8	9	36
subtotal	26	46	48	29	41	190
3H	25	21	22	33	9	110
3B	0	2	0	2	0	4
3T	1	1	1	0	0	3
subtotal	26	24	23	35	9	117
4H	6	8	3	2	0	19
5H	24	18	14	15	8	79
6,7,8	0	0	0	0	0	0
subtotal	30	26	17	17	8	98
TOTAL	125	145	138	135	90	633

Table C-26. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 20, FRESNO COUNTY (MIXED-COUNTY MAJOR COLLECTOR)

Axle Class	Trip Clock Time					Row Totals
	1003-1048	1059-1143	1341-1426	1429-1512	1530-1613	
2H	9	3	2	2	12	28
2B	1	1	2	1	2	7
2T	1	0	0	0	0	1
subtotal	11	4	4	3	14	36
2V	0	0	0	1	0	1
2PF	4	5	1	2	1	13
2PC	0	0	0	0	0	0
2PB	0	1	0	0	0	1
2W	0	0	0	0	0	0
2MH	0	0	0	0	0	0
2MB	0	0	0	0	0	0
2CV	0	0	0	0	0	0
subtotal	4	6	1	3	1	15
3H	1	3	4	4	1	13
3B	0	0	0	0	0	0
3T	0	0	0	0	0	0
subtotal	1	3	4	4	1	13
4H	0	0	0	0	2	2
5H	8	7	9	5	5	34
6,7,8	2	0	0	0	0	2
subtotal	10	7	9	5	7	38
TOTAL	26	20	18	15	23	102

Table C-27. NUMBER OF HDV'S BY AXLE CLASS -- ROUTE 21, FRESNO (MIXED-COUNTY PRINCIPAL ARTERIAL)

Axle Class	Trip Clock Time					Row Totals
	1002-1044	1100-1142	1316-1358	1433-1514	1548-1633	
2H	17	23	25	22	23	110
2B	4	4	13	9	11	41
2T	1	0	0	1	2	4
subtotal	22	27	38	32	36	155
2V	1	1	4	4	4	14
2PF	15	19	18	22	21	95
2PC	0	0	0	0	0	0
2PB	2	2	2	3	1	10
2W	1	3	3	0	5	12
2MH	2	1	2	0	2	7
2MB	0	3	1	3	3	10
2CV	3	2	7	3	4	19
subtotal	24	31	37	35	40	167
3H	16	21	14	9	6	66
3B	1	0	0	0	1	2
3T	1	0	0	1	1	3
subtotal	18	21	14	10	8	71
4H	1	1	0	3	4	9
5H	25	24	21	19	13	102
6,7,8	0	0	0	0	0	0
subtotal	26	25	21	22	17	111
TOTAL	90	104	110	99	101	504

APPENDIX D

SURVEY QUESTIONNAIRE AND CALL RECORD SHEET

CALL RECORD SHEET

Class _____ Body _____ GVW _____

Page No. _____ PES USE ONLY _____

Name* _____ Telephone No. ( ) _____

City _____ Zip _____

*Write that of actual respondent instead of that appearing in computer printouts.

Call #	Date	Time	Outcome	Comments	Interviewer
1					
2					
3					
4					
5					
6					
7					
8					

Result: No Response Disconnected # No HDV Single HDV Multi HDV Other_____

QUESTIONNAIRE FOR HEAVY DUTY VEHICLE USAGE IN CALIFORNIA

Good (morning, afternoon, evening), I am _____ from Pacific Environmental Services. We are conducting a survey for the State Air Resources Board. Specifically, we are studying the usage patterns of trucks and other heavy duty vehicles or HDV throughout California. In order to get a better estimate of truck and other HDV usage we are interviewing a representative sample of such vehicle owners and operators about their typical use patterns. These data will be used by the California State Air Resources Board for planning studies. (When the right person comes to the phone, add the following: (Your participation in this study is very important. Everything you tell us will be strictly confidential. Your name will not be made public in any way in connection with the findings of this study.)

INSTRUCTION: Ask if you are speaking to a fleet manager or a vehicle operator and, if not, ask to speak to a person who knows about the vehicle usage or determine when such a person will be home or in the office. If the right person comes to the phone, restart introduction. Verify telephone number; if incorrect, apologize, terminate and redial.

Q1. First, I need to know how many heavy duty vehicles you or your company own? By heavy duty vehicles we mean trucks, vans, trailers and any other vehicle weighing 6000 pounds or more.

No HDV owned _____ THANK AND TERMINATE

Number of HDV owned _____

Q2. Please tell me the make, body style and model year of each of these HDV's. (If more than 5 HDV's, ask the following questions for the 5 most frequently used vehicles only.)

	MAKE	BODY STYLE	YEAR
V1:	_____	_____	19__
V2:	_____	_____	19__
V3:	_____	_____	19__
V4:	_____	_____	19__
V5:	_____	_____	19__

Q3. Are these vehicles heavier than 3 tons (i.e., 6,000 pounds?) ASK IN SAME ORDER AS RECORDED IN Q 2.)

	YES (Heavier)	NO (Lighter)
V1:	1	2
V2:	1	2
V3:	1	2
V4:	1	2
V5:	1	2

(Proceed to the following questions for only those HDV's answered YES.

If NO is answered for all HDV's, THANK AND TERMINATE.)

Q4. Approximately how many miles per year is each of these vehicles driven? (ASK IN SAME ORDER AS IN Q2. IF DON'T KNOW # MILES PER YEAR, ASK # MILES DRIVEN PER MONTH, WEEK, OR DAY).

V1: _____ Miles Per Year, Month, Week, Day

V2: _____ Miles Per Year, Month, Week, Day

V3: _____ Miles Per Year, Month, Week, Day

V4: _____ Miles Per Year, Month, Week, Day

V5: _____ Miles Per Year, Month, Week, Day

Q5. How often does someone drive each of these HDV's? (CIRCLE THE APPROPRIATE TIME PERIOD FOR EACH VEHICLE.)

V1: _____ Days Per Week, Month, Year

V2: _____ Days Per Week, Month, Year

V3: _____ Days Per Week, Month, Year

V4: _____ Days Per Week, Month, Year

V5: _____ Days Per Week, Month, Year

Q6. On a typical day, how many trips does each of these HDV's make? Here, a trip means a major excursion, either a round trip or a trip to or from a major destination.

V1: _____ Trips per day

V2: _____ Trips per day

V3: _____ Trips per day

V4: _____ Trips per day

V5: _____ Trips per day

Q7. During such a trip, how often does the driver shut-off the engine for 10 minutes or longer?

ENGINE SHUT-OFFS

V1: _____

V2: _____

V3: _____

V4: _____

V5: _____

Q8. How many miles per gallon does each of your HDV's get?

V1: _____ Miles Per Gallon

V2: _____ Miles Per Gallon

V3: _____ Miles Per Gallon

V4: _____ Miles Per Gallon

V5: _____ Miles Per Gallon

Q9. How long have you or has your company owned each vehicle? (ASK IN ORDER OF Q2.)

V1: _____ Yrs _____ Mos.

V2: _____ Yrs _____ Mos.

V3: _____ Yrs _____ Mos.

V4: _____ Yrs _____ Mos.

V5: _____ Yrs _____ Mos.

Q10. Can you tell me approximately, what the present odometer reading is for each vehicle? That is, how many miles in total has it been driven? Can you remember how many miles each vehicle had on it when purchased? (ASK IN ORDER OF Q2.)

	PRESENT ODOMETER	AT PURCHASE
V1:	_____ miles	_____ miles
V2:	_____ miles	_____ miles
V3:	_____ miles	_____ miles
V4:	_____ miles	_____ miles
V5:	_____ miles	_____ miles

Q.11 Do you use the (Vehicle Name) more frequently in a particular season or do you use it evenly throughout the year?

	YES (Use more in)	NO (Equally throughout Year)
V1:	1 _____	2
V2:	1 _____	2
V3:	1 _____	2
V4:	1 _____	2
V5:	1 _____	2

(If YES is answered, ask Q12. If NO is answered, skip Q12 and proceed to Q13.)

Q12. Approximately, what percentage of annual total miles is this vehicle driven in each of the four seasons? (Make sure that the percentages add up to 100%)

	SPRING	SUMMER	FALL	WINTER
V1:	_____%	_____%	_____%	_____%
V2:	_____%	_____%	_____%	_____%
V3:	_____%	_____%	_____%	_____%
V4:	_____%	_____%	_____%	_____%
V5:	_____%	_____%	_____%	_____%

Q.13 Do you use the (Vehicle Name) more frequently on weekdays, or weekends, or do you use it evenly throughout the week?

	WEEKDAY MORE	WEEKEND MORE	EQUALLY THROUGHOUT WEEK
V1:	1	2	3
V2:	1	2	3
V3:	1	2	3
V4:	1	2	3
V5:	1	2	3

(If 1 or 2 is answered, ask Q14. If 3 is answered,skip Q14 and proceed to Q15.)

Q14. Relative to an average weekday usage, how many percent less (or more) is this vehicle driven on a weekend day?

	LESS BY	MORE BY
V1:	1 _____ %	2 _____ %
V2:	1 _____ %	2 _____ %
V3:	1 _____ %	2 _____ %
V4:	1 _____ %	2 _____ %
V5:	1 _____ %	2 _____ %

Q15. Can you tell me what county the (Vehicle Name) is registered in?

	NAME OF COUNTY
V1:	_____
V2:	_____
V3:	_____
V4:	_____
V5:	_____

Q16. Is the (Vehicle Name) used in the county registered in only (home county), the home county and adjacent counties, throughout California, or elsewhere

	HOME COUNTY	ADJACENT COUNTIES	THROUGHOUT CALIFORNIA	ELSEWHERE (NAME OF THE AREA)
V1:	1	2	3	4_____
V2:	1	2	3	4_____
V3:	1	2	3	4_____
V4:	1	2	3	4_____
V5:	1	2	3	4_____

Q17. Now, I would like to ask about usage of the (Vehicle Name) in the past week. Starting today, can you tell me approximately how many miles the vehicle was driven each day?

	V1	V2	V3	V4	V5
SUNDAY					
MONDAY					
TUESDAY					
WEDNESDAY					
THURSDAY					
FRIDAY					
SATURDAY					
PES USE ONLY					

Q18. Finally, I need to know the characteristics of the (Vehicle Name).

A. Approximately, how much does this vehicle weigh when it is empty?

V1: _____ (Pounds, Tons)

V2: _____ (Pounds, Tons)

V3: _____ (Pounds, Tons)

V4: _____ (Pounds, Tons)

V5: _____ (Pounds, Tons)

B. How much load does this vehicle usually carry?

V1: _____ (Pounds, Tons)

V2: _____ (Pounds, Tons)

V3: _____ (Pounds, Tons)

V4: _____ (Pounds, Tons)

V5: _____ (Pounds, Tons)

C. How many axles and tires in total does this vehicle have?

	# AXLES	# TIRES
V1:	_____	_____
V2:	_____	_____
V3:	_____	_____
V4:	_____	_____
V5:	_____	_____

D. How large is the engine in engine displacement and in brake horse power?

	ENGINE DISPLACEMENT		BRAKE HORSE POWER
V1:	_____	(Cubic Inch, CC, Liters)	_____ HP
V2:	_____	(Cubic Inch, CC, Liters)	_____ HP
V3:	_____	(Cubic Inch, CC, Liters)	_____ HP
V4:	_____	(Cubic Inch, CC, Liters)	_____ HP
V5:	_____	(Cubic Inch, CC, Liters)	_____ HP

E. Finally, what type of fuel does this vehicle burn?

	GASOLINE	DIESEL	OTHER
V1:	1	2	3
V2:	1	2	3
V3:	1	2	3
V4:	1	2	3
V5:	1	2	3

THANK AND TERMINATE

APPENDIX E

DATA AND CODING SHEETS FOR TRANSCRIBING QUESTIONNAIRE SURVEY RESULTS

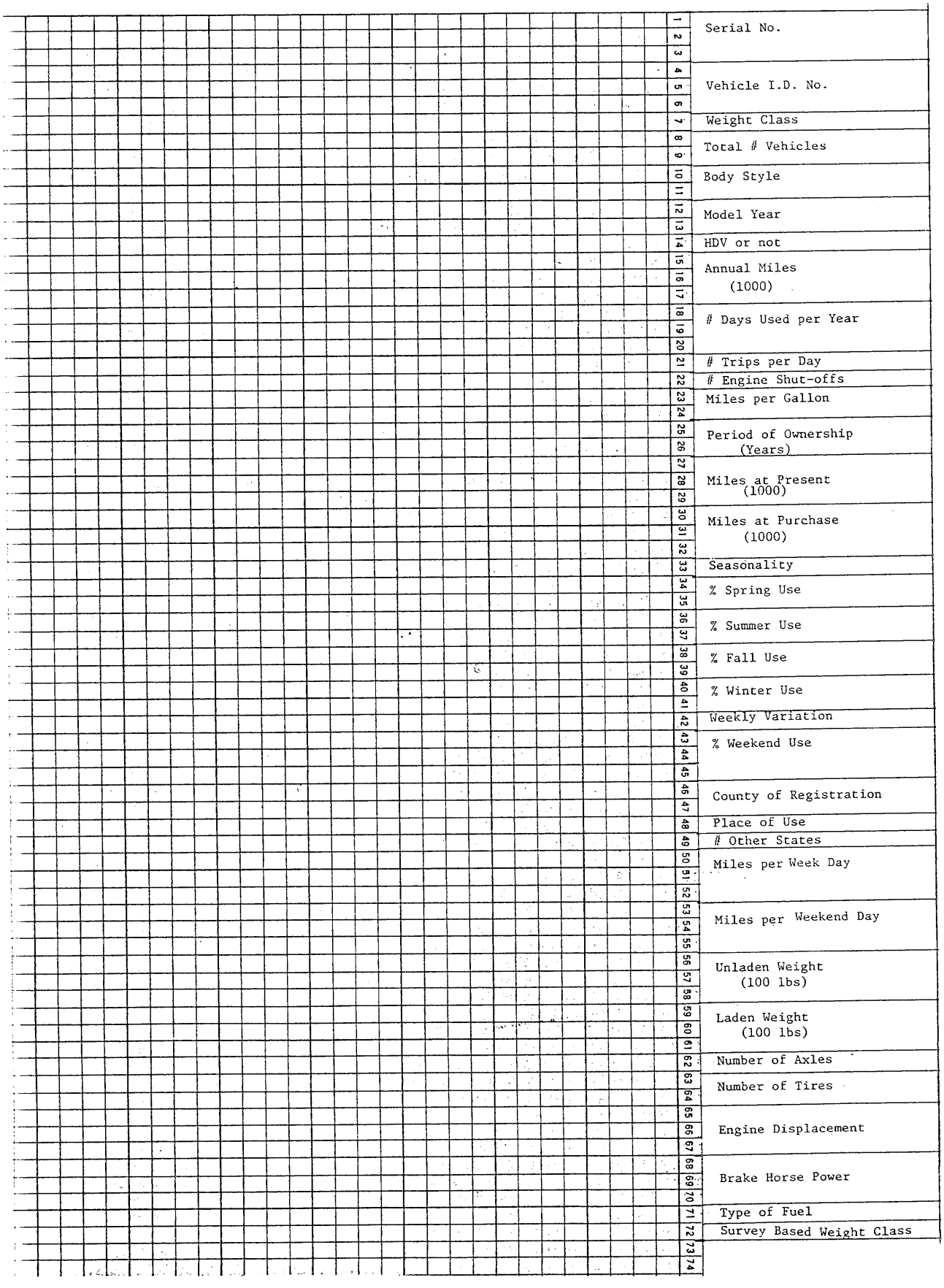
HEAVY DUTY VEHICLE DATA SHEET

	Item	Character(s)
HDV Identification	1. Serial Number for a Successful Interview (1 250)	1-3
	2. Vehicle I.D. Number (1 600)	4-6
	3. Weight Class (3-Light, 4-Medium, 8-Heavy)	7
	4. Total Number of HDV's in the Interviewee's Fleet	8-9
	5. Body Style (1-Regular, 2-Ambulances, ..., 18-Spl Equip)	10-11
	6. Model Year in 19__ ('50 - '84)	12-13
	7. HDV or Not (1-Yes, 0-No)	14
General Usage Information	8. Miles Driven per Year in Thousand Miles	15-17
	9. Number of Days Driven per Year	18-20
	10. Number of Trips per Day	21
	11. Number of Engine Shut-offs per Trip	22
	12. Fuel Economy in Miles per Gallon	23-24
	13. Period of Ownership in Years	25-26
	14. Miles at Present in Thousand Miles	27-29
	15. Miles at Purchase in Thousand Miles	30-32
	16. Seasonality (1-Yes, 2-No)	33
	17. Percentage Usage in Spring	34-35
	18. Percentage Usage in Summer	36-37
	19. Percentage Usage in Fall	38-39
	20. Percentage Usage in Winter	40-41

HEAVY DUTY VEHICLE DATA SHEET (CONTINUED)

Vehicle Characteristics and Registration

Item		Character(s)
21.	Weekly Variation (1-Wkday More, 2-Wkend More, 3-Equal)	42
22.	Percentage Weekend Use (100% = Equal)	43-45
23.	County of Registration (1-Alameda, ..., 58-Yuba, 59-Calif., 60-Non-Calif.)	46-47
24.	Place of Primary Use (1-Home Co., 2-Adjacent Co., 3-Calif., 4-Else)	48
25.	Number of Other States for HDV's Use	49
26.	Miles Driven on a Past Weekday	50-52
27.	Miles Driven on a Past Weekend Day	53-55
28.	Unladen Weight in Hundred Pounds	56-58
29.	Laden Weight in Hundred Pounds	59-61
30.	Number of Axles	62
31.	Number of Tires	63-64
32.	Engine Displacement in Cubic Inches	65-67
33.	Brake Horse Power	68-70
34.	Type of Fuel (1-Gasoline, 2-Diesel, 3-Other)	71
35.	Survey Based Weights Class (0-Non-HDV, 1-Light, 2-Medium, 3-Heavy, 9-Undertermined)	72


1 2 3 Serial No.
4 5 6 Vehicle I.D. No.
7 Weight Class
8 9 Total # Vehicles
10 11 Body Style
12 13 Model Year
14 HDV or not
15 16 17 Annual Miles (1000)
18 19 20 # Days Used per Year
21 # Trips per Day
22 # Engine Shut-offs
23 24 Miles per Gallon
25 26 Period of Ownership (Years)
27 28 29 Miles at Present (1000)
30 31 32 Miles at Purchase (1000)
33 Seasonality
34 35 % Spring Use
36 37 % Summer Use
38 39 % Fall Use
40 41 % Winter Use
42 Weekly Variation
43 44 45 % Weekend Use
46 47 County of Registration
48 Place of Use
49 # Other States
50 51 52 Miles per Week Day
53 54 55 Miles per Weekend Day
56 57 58 Unladen Weight (100 lbs)
59 60 61 Laden Weight (100 lbs)
62 Number of Axles
63 64 Number of Tires
65 66 67 Engine Displacement
68 69 70 Brake Horse Power
71 Type of Fuel
72 Survey Based Weight Class
73 74

APPENDIX F

SHARE OF TRUCK VMT ACCRUED BY CALIFORNIA-BASED VEHICLES

ESTIMATION OF THE SHARE OF INTERCITY HEAVY TRUCK VMT IN CALIFORNIA ACCRUED BY CALIFORNIA-LICENSED VEHICLES

DATA SOURCES

This analysis of the share of intercity heavy truck VMT in California accounted for by California-licensed vehicles is based on data derived from two independent field surveys of intercity motor carrier activity -- the "Empty/Loaded Survey" conducted by the Interstate Commerce Commission, and the National Motor Transport Data Base (NMTDB). Relevant features of these surveys, and the uses made of them, are described below.

EMPTY/LOADED SURVEY

In 1976, the ICC sponsored a major data collection effort that was originally intended to shed light on motor carrier operating efficiency and productivity and, implicitly, the influence of regulatory policies on the performance achieved. With the assistance of state enforcement personnel, over 13,000 over-the-road vehicles* were stopped between January 1976 and January 1977 on over 200 intercity segments of the Interstate Highway System. The drivers of those vehicles were interviewed by trained ICC staff members who recorded a variety of data regarding the vehicle and haul, including the state in which the vehicle was licensed and the state of domicile of the driver.** Over 300 such interviews were conducted on four segments within the boundaries of California, and over 1200 interviews involving California traffic (regardless of where sampled) were conducted in total.

While this survey is now somewhat dated, it is a unique data source for a broad range of motor carrier analyses, since the survey methodology employed yielded a close approximation to a random sample of motor carrier activities. Given the relative stability of commodity flow patterns, this survey is therefore a powerful tool for estimating the relative sizes and characteristics of different portions of the intercity trucking industry. Of course, if possible, results from this survey should be checked against more recent information to ensure their validity for current applications.

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*Trucks with three or more axles, and tractors without trailers.

**For detailed descriptions of survey instruments and sampling procedures, see Interstate Commerce Commission. 1977. Empty/Loaded Truck Miles on Interstate Highways During 1976. April. pp 49-64.

NATIONAL MOTOR TRANSPORT DATA BASE

The NMTDB is an ongoing field survey of intercity trucking activity that has been conducted continuously since 1977 under the sponsorship of (in order) the Association of American Railroads, Charles River Associates, and the former data collection subcontractor to both, Transportation Research and Marketing. In 1982, approximately 16,000 detailed questionnaires (see attachment) were administered to intercity truck drivers at 18 truckstop locations spread throughout the country, including two locations in California (Bakersfield and Redding). At each location, 75 interviews were conducted each month encompassing different days of the week and times of day.

The NMTDB data are newer and generally more detailed than the ICC data (though, for the questions involving the locations of registration and domicile, the surveys are very similar). However, due to the use of truckstops as sampling locations, and the unavailability to the survey of state enforcement personnel to stop vehicles on the highway itself, the sampling methodology is inherently nonrandom and the data may, therefore, be affected significantly. For instance, empty vehicles and long-haul moves are disproportionately likely to make use of truckstops (and thus be included in the NMTDB sample), while LTL drivers tend to use company (terminal) facilities in place of truckstops. Indeed, the NMTDB surveyors deliberately attempt to avoid LTL drivers as part of the sampling process. The raw survey data must therefore be carefully stratified and/or weighted before it can be used to draw conclusions concerning the universe of intercity trucking activity.

Despite their differences, the two surveys appear to encompass generally comparable types of heavy truck movements. For instance, as shown in Table 1, the distributions of cargo weights observed in the Empty/Loaded Survey and NMTDB are quite similar.*

ANALYSIS APPROACH

Analysis of the license characteristics of California heavy truck VMT has involved three steps:

1) Estimate shares of VMT involving traffic of different types.

2) For each traffic type, estimate percentage of its VMT that is California licensed.

3) Validate results where feasible.

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*The slightly higher incidence of light lading in the Empty/Loaded Survey may be attributable to the higher coverage of LTL traffic in that survey.

Each of these steps is described below.

ESTIMATE VMT SHARES

Using the Empty/Loaded Survey, moves observed at California sampling locations were analyzed to determine shares for each of the following types of traffic:

- Intrastate -- intercity moves with both origin and destination in California.
- Interstate -- intercity moves with either origin or destination, but not both, in California.
- Bridge -- intercity moves with both origin and destination outside California, but that pass through California en route.

These shares are presented in Table 2, and are calculated using formulae analogous to those presented in Appendix D of the Empty/Loaded Truck Miles report cited previously, which adjust for known sampling rate differences across observations. To aid in the eventual interpretation of results, shares are also estimated for each of the nine traffic types defined by three weight groups* and the three origin/destination classifications described above. As shown in Table 2, almost two-thirds of all California intercity heavy truck VMT is intrastate, over one-third is interstate, and very little is bridge (which will therefore not be analyzed further).

PERCENT VMT CALIFORNIA-LICENSED

Using the Empty/Loaded Survey, the percent of VMT that was California-licensed was estimated from the California sampling locations for each traffic type. This task was complicated by the fact that only one-third of the survey forms contained responses to the state license question. Analysis of nonrespondents revealed that virtually 100 percent were company drivers (and not owner-operators). However, among company drivers who did respond to the state license question, the overwhelming majority (over 95 percent) indicated that their state of domicile was the same as the state in which the vehicle was licensed. This is consistent with the fact that company drivers tend to be based in a given area and used on shorter hauls, while owner-operators are used on longer hauls. Therefore, in cases where the state license question was not answered, the driver's state of domicile was used as a proxy.

---

*Weight Group 1 -- Tare weight less than 25,400 pounds.
Weight Group 2 -- Tare weight greater than or equal to 25,400 pounds, but less than 29,050 pounds.
Weight Group 3 -- Tare weight greater than or equal to 29,050 pounds.

VALIDATION

A number of steps were taken to validate these results. First, the aggregate intrastate and interstate percentages of VMT that is California-licensed (as calculated using the "License or Domicile" method described previously) were compared to corresponding values estimated without substituting the state of domicile for missing state license values. As shown in Table 2, the results do not appear to have been affected significantly by the use of domicile as a proxy.

Second, the interstate percentages of VMT that is California-based were compared to corresponding values estimated from the entire database (i.e., all VMT of California interstate traffic, regardless of whether it accrues in California or not). Again, as shown in Table 2, no major discrepancies are evident.

Third, the results from the Empty/Loaded Survey were compared to corresponding values from the NMTDB. Because of the NMTDB truckstop sampling methodology (and the associated underrepresentation of short hauls -- i.e., intrastate relative to interstate moves), this comparison is limited to the percentages of VMT that is California-licensed. Even within a given traffic type, it is reasonable to anticipate that NMTDB results will systematically indicate a lower participation of California-licensed vehicles, since such vehicles are more likely to have local (i.e., non-truckstop) sources from which to procure truckstop-type services, and will thus tend to be avoided in the NMTDB's California stations.* In this light, as shown in Table 2, the NMTDB results are consistent with the Empty/Loaded Survey results.** However, the possibility cannot be ruled out that some exogenous influences may have arisen between 1976 and 1982 that caused a relative increase in out-of-state registration of heavy trucks.

Finally, the California-licensed percentages were tabulated separately for each of the four ICC sampling locations in California, plus five nearby segments involving significant California traffic flows. These results are shown in Table 3.

---

*For this reason, the value drawn from the entire database -- including non-California sampling locations -- for California interstate traffic is more representative than the other NMTDB values for this traffic.

**NMTDB values in Table 2 were calculated based on relationships identified in Appendixes D and F of the Empty/Loaded Truck Miles report cited previously. It is implicitly assumed that within each of the traffic types analyzed, factors such as the underrepresentation of LTL traffic (which generally represents a small fraction of total heavy truck VMT) in the NMTDB sample do not systematically affect the California-licensed percentages.

Table 1

DISTRIBUTIONS OF LOADED MOVEMENT CARGO WEIGHTS
(Percent)

CALIFORNIA TRAFFIC

Cargo Weight (lbs.)	Empty/Loaded Survey	NMTDB	
		Redding	Bakersfield
1-4999	2.979	0.229	0.670
5000-9999	8.511	1.950	2.570
10000-14999	5.532	5.046	4.693
15000-19999	4.681	5.161	10.726
20000-24999	6.383	5.275	9.721
25000-29999	4.681	3.440	5.363
30000-34999	8.936	6.193	7.598
35000-39999	8.085	6.651	10.615
40000-44999	24.681	29.817	34.749
45000-49999	9.787	28.440	12.067
50000-54999	14.043	6.193	0.782
55000+	1.702	1.606	0.447
	(235)	(872)	(895)

TOTAL DATABASE

Cargo Weight (lbs.)	Empty/Loaded Survey	NMTDB
1-4999	3.506	1.049
5000-9999	5.898	2.966
10000-14999	7.455	5.360
15000-19999	7.274	6.360
20000-24999	8.199	6.542
25000-29999	8.229	5.411
30000-34999	9.284	7.692
35000-39999	14.629	12.311
40000-44999	23.289	34.814
45000-49999	7.626	13.165
50000-54999	3.074	2.796
55000+	1.537	1.533
	(9,953)	(15,913)

( ) -- Number of observations.

Table 2

SUMMARY OF RESULTS

	ICC EMPTY/LOADED SURVEY				NMTDB			
		% VMT California-Licensed			% VMT California-Licensed			
	Share of Total Miles*	California Sampling Locations License/Domicile	California Sampling Locations License Only	Total Database-License/Domicile	Redding	Bakersfield	Weighted Average**	Total Database**
Intrastate	.631	.967 (188)	.966 (47)	--	.879 (33)	.846+ (13)	.858 (33)	--
Weight Group 1	.230	.985 (74)		--				
Weight Group 2	.208	.936 (63)		--				
Weight Group 3	.184	.984 (48)		--				
Interstate	.350	.296 (113)	.268 (50)	.303 (1197)	.300 (810)	.068 (867)	.109 (1704)	.143 (4695)
Weight Group 1	.101	.562+ (24)		.501 (119)				
Weight Group 2	.097	.331 (37)		.333 (304)				
Weight Group 3	.160	.257 (51)		.271 (720)				
Bridge	.019	.000+ (4)	.000+ (3)	.334+ (19)	.068 (44)	.136+ (22)	.115 (52)	--
Weight Group 1	.004	.000+ (1)		1.000+ (1)				
Weight Group 2	.007	.000+ (1)		.139+ (2)				
Weight Group 3	.010	.000+ (2)		.269+ (14)				
	(301)							

( ) -- Number of observations.

*Shares calculated within weight groups collectively sum to 100 percent, but differ slightly from the corresponding shares for the origin/destination classification alone due to the exclusion of a small number of observations for which tare weights were recorded as "0".

**Weighted by passing counts to account for sampling rate differences.

+Small sample size.

Table 3

PERCENT OF INTERCITY VMT BY CALIFORNIA LICENSE/DOMICILE TRUCKS
AT ICC EMPTY/LOADED SURVEY LOCATIONS IN AND NEAR CALIFORNIA

ICC Survey Segment No.	Highway No.	Segment	Sampling Location	% VMT California License/Domicile
003*	5	Portland-Sacramento	Cottonwood, CA	.452 (59)
004*	5	Sacramento-Los Angeles	Castaic, CA Wheeler Ridge, CA	.884 (85)
005*	5	Los Angeles-San Diego	San Onofre, CA	.897 (80)
013	80	Sacramento-Salt Lake City	5 miles west of Reno, NV	.450 (128)
014	15	I70-Barstow	St. George, UT	.218 (60)
015*	15	Barstow-San Bernardino	Cajon, CA	.558 (81)
016	10	Los Angeles-Phoenix	Ehrenberg, AZ	.410 (81)
017	40	Barstow-Flagstaff	Kingman, AZ	.209 (60)
020	8	San Diego-Casa Grande	Yuma, AZ	.483 (69)

( ) -- Number of observations.

*California sampling locations.

№ 829900

NATIONAL MOTOR TRANSPORT DATA BASE QUESTIONNAIRE

ATTACHMENT A
CONFIDENTIAL

✓ DATE _____ TRUCK STOP LOCATION _____ STATE _____ 7 mm yy 10 11 16

I. VEHICLE INFORMATION —

(A) Do you drive for a: 1) Regular route common carrier 2) Irregular route common carrier
1 Line division 3) Private carrier
2 Special commodities division 1. Manufacturing company 3. Both
4) Contract carrier 2. Distributing company
1. Shipper's identity 5) Exempt carrier
2. Carrier's identity 6) Agricultural co-op

A 17 A1 18

(B) What make is your tractor? _____ Trailer? _____ B1 19 B2 20

(C) What type of trailer are you pulling? 1) Van 2) Liquid tanker 3) Reefer 4) Flatbed 5) Moving Van
6) Auto Rack 7) Dry bulk tanker 8) Livestock 9) Drop Frame A) Dumpbody B) Grain C) Piggyback vehicles
D) Other ....Same on previous load? ☐Yes ☐No If no, what type? _____ C 21 C1 22

(D) Do you own this trailer? 1) Yes 2) No ..... D 23

(E) If no, is it (are they): 1) Rental 2) Company-owned 3) TOFC 4) Container ..... E 24

(F) What is (are) your trailer length(s)? _____ 1st Feet _____ 2nd Feet F1 25 26 F2 27 28

(G) Year of manufacture: 1) Tractor? _____ 2) Trailer? _____ G1 29 30 G2 31 32

(H) What make and horsepower engine do you have in your tractor? 1) _____ Cummins 2) _____ Caterpillar 3) _____ Mack
4) _____ Detroit Diesel 5) _____ IHC 6) _____ Other H 33 H1 34 36

(I) How many miles do you average per gallon? _____ MPG ..... I 37 38

(J) Has anything been done to your vehicle to improve this mileage? 1) Formula engine 2) Fan clutch 3) Radial tires
4) Wind deflector 5) Other _____ 6) No changes ..... J 39

(K) Are you leased to or are you driving for an ICC certificated carrier: 1) Yes 2) No ..... K 40

(L) Do you have: 1) An ICC/MC number 2) An intercorporate haul permit 3) A processed food haul permit 4) None of the above L 41

II. OPERATION CHARACTERISTICS —

(A) Do you now own this tractor? 1) Yes 2) No .... How many (total) do you own? _____ ..... A 42 A1 43

1. If no, have you ever owned your own tractor? 1) Yes 2) No If yes, from when to when? _____ to _____ 1 44 1a 45 46 1b 47 48

■ 2. If yes, when did you purchase this tractor? _____ year 2 49 50

■ 3. If you are financing your tractor, are you current on your payment? 1) Yes 2) No 3) Own outright..... 3 51

■ 4. Are you: 1) Permanently leased 2) Operating as an independent or 3) Operating on your own ICC authority? 4 52

(B) How are you paid? 1) Percentage of revenue: _____ % Percent 2) By the mile: _____ ¢ Loaded rate 3) By the mile: _____ ¢ Empty rate
5) Wage: $ _____ Amount Hour 6) Wage: $ _____ Amount Week 7) Flat Rate: $ _____ Amount
9) A combination of above (mark each) B1 53 54 55 56 57 58

(C) Do you trip lease? 1) Yes 2) No. If yes: 59

1. Is this trip a trip lease? 1) Yes 2) No C1 60 C2 61 62

2. How many times a year do you trip lease? # _____

✓ (D) What state is this truck registered in? _____ Gross vehicle weight? _____ GVW D1 63 64 D2 65 67

✓ (E) What state do you live in? _____ ..... E 68 69

III. OPERATOR PROFILE —

(A) How long have you been driving for your present company? _____ Year(s) _____ Month(s) ..... A 70 72

(B) How long have you been driving a truck? _____ Year(s) _____ Month(s) ..... B 73 75

(C) How old are you? _____ Year(s) ..... C 76 D 77 D1 78

(D) Are you affiliated with any professional drivers' organization or union? 1) Yes 2) No If yes, who? _____ E 79 80 81

(E) What actual highway speed do you drive? _____ MPH ..... F 82 83

(F) What average speed do you figure for your overall trip (meals and fuel stops included)? _____ MPH G1 84 86 G2 87 88

Δ (G) How many miles do you drive? 1) _____ Per year 2) _____ Last month H 89

(H) Do you drive? 1) Solo or 2) Team ..... I 90 I1 91 J2 92 93

(I) In the past 90 days, have you been checked or hassled over: 1) Brakes 2) Vehicle condition/Safety 3) Length
4) Operating authority 5) Log 6) Weighed at portable scales 7) Speed 8) Other 9) Not hassled
By whom? 1) Federal 2) State What state(s)? _____ J3 94 J4 95 96 97

IV. MOVEMENT INFORMATION —

Δ (A) What direction are you traveling? 1) East 2) West 3) North 4) South 5) Layover .....

(B) Are you: 1) Loaded 2) Empty .....

1. If empty: From: _____ CITY OR TOWN _____ STATE

To: _____ CITY OR TOWN _____ STATE

2. If empty, do you have a load booked that you are enroute to pick up? 1) Yes 2) No .....

(C) What was your origin cargo weight? _____ CWT .....

(D) How full (cubically) was your trailer when you started: 1) Full 2) ¾ 3) ½ 4) ¼ .....

(E) What commodity are you hauling? _____ 1) Ex 2) Reg

✓ (F) What is your current haul? From: _____ CITY OR TOWN _____ STATE

To: _____ CITY OR TOWN _____ STATE

(G) Including your final delivery, how many drops will you make? _____

(H) Is your load: 1) Palletized 2) Packaged goods on floor 3) Bulk, or 4) Other? If palletized, do you exchange pallets? 1) Yes 2) No

(I) Who loaded your load: 1) Driver 2) Shipper 3) Both 4) Lumpers .....

(J) Who will unload your load: 1) Driver 2) Consignee 3) Both 4) Lumpers .....

(K) How long did it take you to get loaded and away from the dock? _____ hours .....

Δ (L) What was your previous haul? From: _____ CITY OR TOWN _____ STATE

To: _____ CITY OR TOWN _____ STATE

(M) Was it a trip lease? 1) Yes 2) No .....

(N) What commodity did you haul? _____ 1) Ex - 2) Reg

(O) What did the load weigh? _____ CWT .....

(P) Including your final delivery, how many drops did you make? _____ .....

(Q) Did you have to deadhead between the destination point of your previous load and the origin point of this load? 1) Yes 2) No

(R) Did you have to deadhead to pick up at origin point of previous load? 1) Yes 2) No .....

1. If yes, from where? _____ CITY OR TOWN _____ STATE

(S) Did you have to layover for current load? 1) Yes 2) No If yes, how long? _____ Day(s) .....

(T) What does this load pay? 1) Current load $ _____ 2) Previous load $ _____

(U) Is this revenue: A. Current load: 1. Gross? 2. Net to the truck? 3. Your wages?
B. Previous load: 1. Gross? 2. Net to the truck? 3. Your wages?

(V) Were you paid a different way on the previous haul? 1) Yes 2) No .....

(W) If yes: How?

1) Percentage of Revenue: _____ % Percent 2) By the mile: _____ ¢ Loaded rate 3) By the mile _____ ¢ Empty rate

5) Wage: $ _____ Amount Hour 6) Wage: $ _____ Amount Week 7) Flat Rate: $ _____ Amount

9) A combination of above (mark each) .....

■ (X) If owner operator, what is the lowest rate per mile you would accept for a backhaul load? $ _____

V. SUPPLY CHARACTERISTICS —

(A) What type of services did you purchase at this truckstop?

1. $ _____ Fuel 2. $ _____ Oil .....

3. $ _____ Services 4. $ _____ Food 5. $ _____ Merchandise

(B) How many hours do you drive before you stop for: 1) Food _____ Hours 2) Fuel _____ Hours

(C) Do you regularly stop at this truckstop? 1) Yes 2) No If yes, how many times a month? # _____

(D) How many hours will you actually drive today? # _____ .....

VI. COMMENTS —

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ASSET